AN AGILE HOLISTIC GAMIFIED PEDAGOGICAL DESIGN FRAMEWORK TO PROMOTE THE SYNERGY BETWEEN TEACHERS AND GAME DEVELOPERS

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Abstract

The young generation is passionate about technology and the update of learning/teaching tools is a necessity to match their current interest. The existing literature on gamification supports its benefit on students' engagement, learning acquisition, skills and resilience. This research discusses gamification concept in a pedagogical context, in which there appears to be a lack of clarity about the meaning provided in the literature. The balance of gamification design to cultivate students' both extrinsic and intrinsic motivation. Then, it describes a focused interest in teachers' roles as key stakeholders in gamification design. A literature review carried out to investigate current practices of gamification design and identify the barriers. There is inadequate integration of learning that theories might preserve the pedagogical aspect of the design. However, these theories might not be reciprocated by game developers. Conversely, game design terminology could be challenging for some teachers. There is a need to find common ground where both parties can express their design decisions and communicate efficiently. Therefore, there is a need for a communication platform that includes the two stakeholders—teachers and game developers—in the design process. This would keep each of them focused on their area of expertise and avoid the disadvantage of taking up too much of their time (i.e. the teachers will not dive into programming or game design technicalities). The research developed an Agile Holistic Gamified Pedagogical Design (AH-GPD) Framework to support the synergy between teachers and game developers in the design process. The framework's high-level is based on two software design models: Analysis, Design, Development, Implementation, and Evaluation (ADDIE) and Usability-Software Development Life Cycle (U-SDLC). In this research, a comprehensive search was conducted to identify the gamification elements in a pedagogical context. The identified gamification elements are used to enhance the practicality of the framework and its adaptability by teachers. Then, the teachers' role was defined using in the design process using a quantitative approach to categorise the gamification aspects from a teacher's point of view. The supported categorisations are teacher-driven, game developers-driven or shared task. The next step of the research is the practical validation of the gamification elements utilising the think aloud interview protocol (qualitative approach) with teachers. Following that, a validation of the research with game developers through interviews to enable the collaboration with teachers and refining the framework. The validation of the research with both teachers and game developers concludes to building Pedagogical Game Design Document (Ped-GDD) as communication template. An evaluation of the Ped-GDD was conducted with a panel of experts representing the two stakeholders; teachers and game developers. The evaluation was conducted through a semi-structured interview, and the criteria is adopted from the Technology Acceptance Model (TAM). The features assessed are; Easy to learn, Easy to use, Usefulness, Comprehensiveness, Adaptability and Intention to use in the future.

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Dedication

To my parents

To my children *Mostafa* and *Malak*,

Your kindness and smiles supported me through this journey

Publication

P 1. Saggah, A., Atkins, A. & Campion, R. (2020a). A Pedagogical Game Design Document (Ped-GDD) to Promote Teachers' Engagement in the Kingdom of Saudi Arabia. In: Advances in Intelligent Systems and Computing. [Online]. 20 February 2020, London: Springer. Available from: https://www.springer.com/series/11156. [Accessed: 18 March 2020].

P 2. Saggah, A., Atkins, A. & Campion, R. (2020b). A Repository Collaboration Model to Gamify Education Using Synergistic Digital Hub. In: 2020 Fourth World Conference on Smart Trends in Systems Security and Sustainability (WorldS4). 2020, London: IEEE. (In press)

P 3. Saggah, A., Atkins, A. & Campion, R. (2020c). A Review of Gamification Design Frameworks in Education. In: 2020 Fourth International Conference On Intelligent Computing in Data Sciences (ICDS). 2020, Fez. (In press)

P 4. Saggah, A., Atkins, A. & Campion, R. (2020d). Experts Evaluation of a Pedagogical Game Design Document (Ped-GDD). In: 2020-International Conference on Computing and Information Technology: ICCIT_1441. 2020, Tabuk: IEEE. (In press)

P 5. Saggah, A., Atkins, A. & Campion, R. (2020e). The Role of Game Developers in a Collaborative Pedagogical Game Design. In: 12th annual International Conference on Education and New Learning Technologies: EDULEARN20. 2020, Palma de Mallorca: IATED Academy.

P 6. Saggah, A., Campion, R. & Atkins, A. (2020f). An Agile Holistic Framework to Support Teachers in Pedagogical Gamification Design. In: 2019 International Conference on Advances in the Emerging Computing Technologies (AECT). 2020, Madinah: IEEE, p. (In Press).

P 7. Saggah, A., Campion, R. & Stanier, C. (2018a). A Collaborative Gamification Design Framework in an Educational Context. In: ICERI2018 Proceedings. [Online]. 2018, Seville: IATED, pp. 2410–2414. Available from: https://library.iated.org/publications/ICERI2018.

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List of Abbreviation

AH-GPD	**Agile Holistic Gamified Pedagogical Design**
GDD	Game Design Document
HCI	Human-computer Interaction
ICT	Information Communication Technology
KSA	Kingdom of Saudi Arabia
Ped-GDD	Pedagogical Game Design Document
SDH	Synergistic Digital Hub
TAM	Technology Acceptance Model

Chapter 1. Research Methods

1.1 Introduction

This chapter discusses the background and motivation behind this research. In addition, the chapter emphasises the significance of gamification in a learning context and states the aim and objectives of the study. Then, it describes the choices made while conducting the research regarding philosophy, approaches and tools. Finally, a summary of the thesis is offered, highlighting the main contributions of each chapter towards the research outcome.

1.2 Background and motivation

The use of emerging technologies to promote learning, such as mobile technologies and online courses, is an interesting research area. According to the Gamelearn website, games improve acquisition retention by 90% and also improve students' skills by 20%; however, no details of the study are presented (Gamelearn, n.d.). Gamelearn is a corporation that works in gamification for learning and training purposes, with 10 years of industry experience. They have received several awards, such as the 'Gold Medal 2019 for International Serious Play Awards-Global' and 'Best of eLearning! 2016' from the eLearning! Media Group-USA.

Research shows that using online game exercises increases students' motivation towards learning (Lai *et al*, 2014). It has been suggested that using a graphical interface in a library catalogue helped to increase the task completion rate between 66% and 100% based on the children's familiarity with computer usage (Wu *et al*, 2014). Many studies have discussed the benefits of gamification as a motivation boost. The literature indicates that using gamification can improve students' performance by providing positive influences on their motivation, attention and engagement (Morillas Barrio *et al*, 2016; Dumitrache & Almăşan, 2014). Another study discussed the benefits of games as part of a preschool program to improve children's ability in both Thai and English. The study was conducted with Thai children, and the evaluation indicates that over 90 % of the participants met the target goal (Choosri *et al*, 2017).

Gamification involves applying game elements in a non-gaming context (Deterding *et al*, 2011; Mystakidis *et al*, 2014; Browne *et al*, 2014), and the term can be applied to both electronic and non-electronic forms of games. In this research, gamification involves the electronic implementation of gamification elements in the learning context. Some studies specifically suggest that the use of rewards in many forms, such as leader boards, points, badges, etc., will help maintain students' interest in playing educational games and, therefore, enhance the educational experience (Kapp, 2012; Chou, 2016; Bouzid *et al*, 2017; Mekler *et al*, 2017). Other studies (Bellotti *et al*, 2013; Fitz-Walter *et al*, 2017) have discussed the positive effects of gamification elements in students'

engagement and enjoyment in their courses. More comprehensive studies, which have examined students in university courses, have indicated that gamification enhanced students' motivation, attention, engagement and learning performance (Morillas Barrio *et al*, 2016). The use of gamification as a teaching tool is well known as a motivator that offers both an entertaining style and effective means measuring learning acquisition. Gamification elements, such as rewards, leader boards and social engagement, have been used by teachers as part of in-class activities to reinforce learning objectives. The incorporation of electronic games in a learning context has been shown in the literature to be beneficial (Morillas Barrio *et al*, 2016; Fitz-Walter *et al*, 2017). The forgoing discussion demonstrates that gamification represents an opportunity to enhance the learning experience.

The Saudi Arabian 2030 Vision features 13 vision realisation programmes, including the Human Capital Development Program. The development scheme aims to improve the educational outcomes for citizens of all ages by teaching the skills needed to face challenges and learn emerging technologies while managing the rapid change of experience requirements. The government vision is to extend the education system for children by building an empowered citizen character (Council of Economic and Development Affairs, 2016). As learning is an essential part of the Saudi Arabian government plan, there is a need to build a framework based on research to avoid exhausting financial and human resources without achieving guaranteed results. As gamification research confirms the beneficial effect on learners' motivation, the Kingdom of Saudi Arabia (KSA) needs to adopt gamification as one of the approaches to engage young citizens to learn at an early stage. This thesis proposes using the two opportunities, gamification benefits and the KSA education development scheme as part of 2030 Vision , which are illustrated in the green ellipse in Figure 1-1 as the motivation to pursue this research.

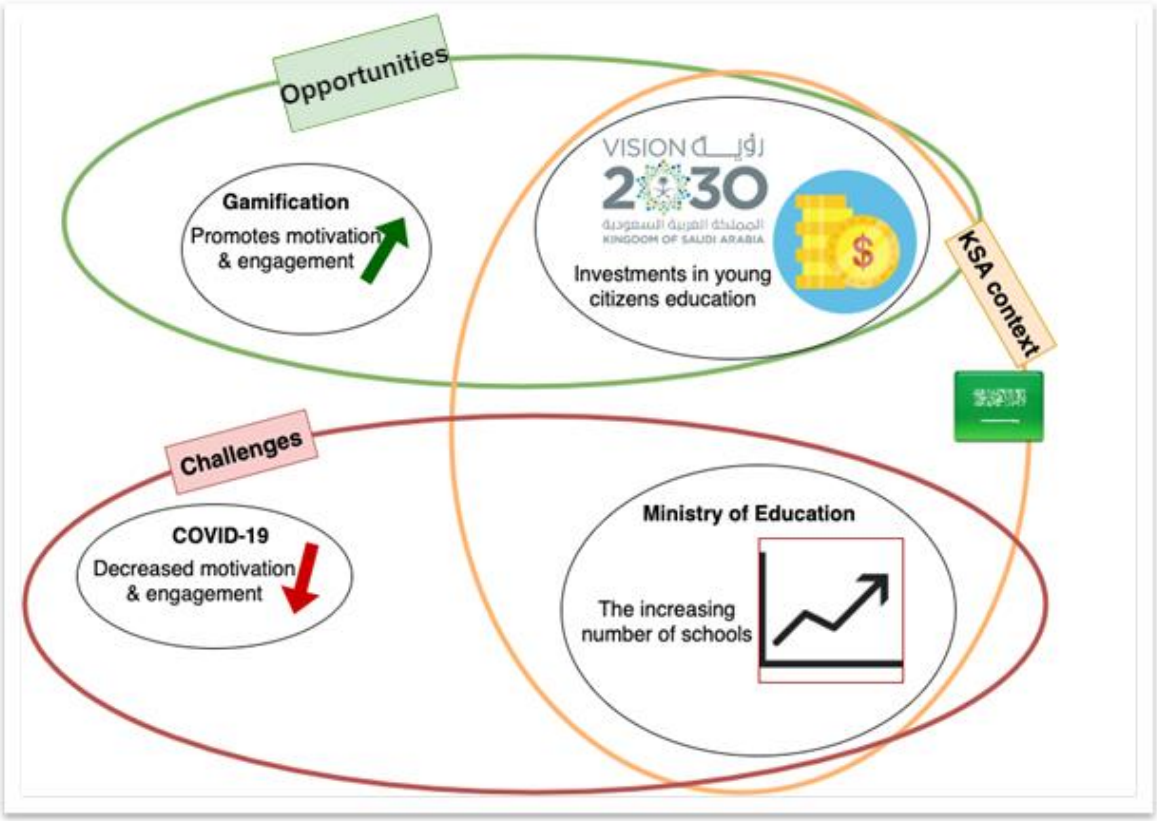


Figure 1-1. Background and Motivation

Another challenge is related to the context for conducting the present study—that is, the COVID-19 lockdown, as illustrated in Figure 1-1. The global pandemic has led to unprecedented measures being taken in many countries, including school closures, which poses obstacles for pupils' learning. The current pause in conventional teaching has created an opportunity to embrace a new attitude towards gamification platforms to support new learning techniques. There have been many attempts to overcome these challenges, for example, the daily lessons provided by BBC Bitesize. The BBC is a public service broadcaster in the United Kingdom. In an attempt to support home schooling, the BBC Bitesize webpage offers the following support: 'Bitesize guides are written by teachers and subject experts and are mapped to follow the curricula in the UK' (BBC, 2020b). There are daily updates of three new lessons that include all school years, as illustrated in Figure 1-2.

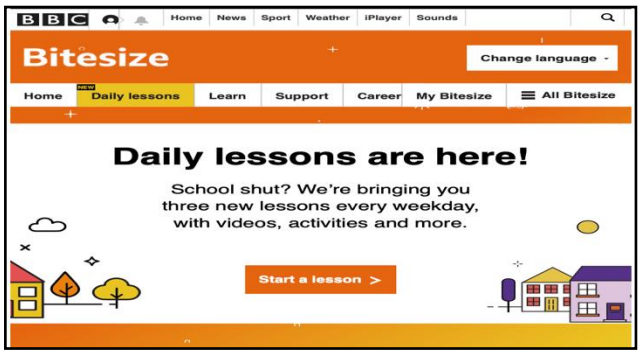


Figure 1-2. BBC Daily Lesson Screenshot (BBC, 2020b)

The lesson includes textual information outlining the topic and instructions, together with a short video of parts of the lesson, printable games and sometimes an interactive game. The website works as a distribution platform, and there is no communication or feedback given to parents and students. For example, there is no student profile and, consequently, no personalization or record of individual progress on the website. Adding progress information for individuals is considered a gamification element that provides a sense of accomplishment (Chou, 2016). Another example of current practices to overcome school closures is the 'English with Holly' channel on YouTube (BBC News, 2020) for broadcasting lessons to support learning during the lockdown. Holly provides English lessons to support Key Stage 2 students. Some schools have decided to continue to deliver virtual classes using video conference applications, while others use weekly email activities sheets. All efforts may be appreciated by parents considering the abrupt nature of school closures; however, these resources sometimes lack the motivation for students, which can be met through gamifying the learning environment for the pupils. Another challenge is related to the context of KSA and the increase in the number of students, which is presented in Chapter 4 Section 4.3.

Also related to the COVID-19 pandemic, a children's game has been developed to promote social distancing and an awareness of precautionary measures, and it recorded 10,000 plays in two days. A reviewer of the game reported that a realistic goal of the game is to simulate the current situation, as game points are awarded based on how many lives are saved by taking action, such as collecting masks, during play (BBC, 2020a).

Chadwick (2020) described an educational game co-designed by a psychologist from the UK. This indicates the need for collaboration among experts to achieve the game's goals. According to Choosri *et al* (2017), gamification design is an accumulated process that needs the collaboration of experts to build a learning environment. The incorporation of teachers' pedagogical knowledge would improve the educational content of the game. In this research context, teachers are the co-designers of gamified pedagogy. The literature indicates that the role of teachers in gamification design is acknowledged but has not been sufficiently investigated. Furthermore, the research area is under-explored in Saudi Arabia. In addition, this research identifies gamification elements that

can be effectively applied individually or collectively (Kapp, 2012). The barrier of teachers' technical knowledge is identified in the preliminary findings of this research (see Chapter 5, Sections 5.3.3 and 5.5). Accordingly, the proposed framework integrates teachers' pedagogical knowledge (without the technical aspect) with game developers' technical skills. The development of a gamified pedagogical framework bridges the gulf between teachers' theoretical knowledge of gamification in a pedagogical context and its practical utilisation. The proposed framework is used as an anchor point for the gamified pedagogy design process, providing an agile holistic structure that illustrates the synergy between teachers and game developers.

This high-level proposed framework has four stages; Requirements, Gamification Design, Implementation, and Testing and Evaluation. However, the focus of this research will be mainly concerned with Stage 2: gamification design that facilitates collaboration between teachers and game developers by including pedagogical gamified requirements. The elements and sub-elements of gamification design (Stage 2) are used to develop a Pedagogical Game Design Document (Ped-GDD) template. The template provides a platform to migrate teachers' knowledge from in-class activities to gamified learning. The Ped-GDD template provides illustrations and examples to simplify the process for the teachers and ensure consistency with elements' and sub-elements' meanings. The extension of the research of the Ped-GDD to become part of an e-Government scheme in KSA would promote resources collaboration amongst teachers in educational software tool development.

1.3 Aim and objectives

The research aims to develops an agile and holistic framework for gamified pedagogical material that incorporates knowledge from two domain experts—teachers and game developers—in the design process.

To achieve this aim, the following objectives have been developed:

1. To conduct a literature review of the gamification concept and its impact on students.
2. To identify, within the literature review, the practices of gamification design in the learning context, and teachers' roles as key stakeholders in gamification design.
3. To identify the gamification elements related to learning through a comprehensive/broader literature search that includes gamification mechanics, dynamics and related aspects.
4. To develop a framework that supports teachers in gamification design.
5. To conduct a survey of primary school teachers in KSA to categorise the gamification elements.
6. To validate the framework practicality from teachers' perspectives through focus group interviews.

7. To identify the Human–Computer Interaction (HCI) sub-elements from the literature review.
8. To validate the research with game developers using interviews.
    a. To validate the identified HCI sub-elements in a gamification context.
    b. To validate the gamification design elements and sub-elements identified in teachers' interviews.
9. To identify the Gamification Design Document (GDD) components in the game design industry.
10. To evaluate the Ped-GDD as the research outcome with a focus group, including both teachers and game developers.
11. To critically review the research and suggest areas for future work.

1.4 Contribution to knowledge

The primary contribution of this thesis is the development of an Agile Holistic Gamified Pedagogical Design (AH-GPD) framework. According to the literature search of the Scopus database, the research area is under-explored in Saudi Arabia, which shows a context gap (as discussed in Chapter 2, Section 2.6). Therefore, there is a need to support Saudi teachers in adopting new technologies to provide more interesting learning platforms. The proposed framework is meant to improve lesson designs and content to be compatible with the digital era. The framework would bridge the gulf between teachers and game developers by providing a communication platform. This would allow both teachers and game developers to remain focused on their area of expertise (i.e. the teachers will not be expected to delve into programming or game design technicalities). The research also contributes to the body of knowledge by offering a critical review of existing gamification design frameworks used in the educational context to explore current practices and find the barriers and challenges that hinder teachers' integration in the design process.

In the process of identifying the gamification elements, a comprehensive literature review was conducted to identify elements of the framework design stage. This was refined by the primary research to include sub-elements for the gamification design. As an outcome, the Ped-GDD has been constructed with an illustrative example provided to support its purpose of communicating the pedagogical input as structured requirements to the game developers

1.5 Research paradigm

The research paradigm is essential to guide the research towards identifying a suitable methodology and, therefore, the tools used for data collection. This section discusses the research paradigm for this study, providing an explanation of research philosophies, approaches and design. In addition, it discusses the rationale for the decisions made during this research journey. The

research 'onion' presented in Saunders *et al* (2009) identifies the levels of the research process. These research journey choices are illustrated in Figure 1-3 .

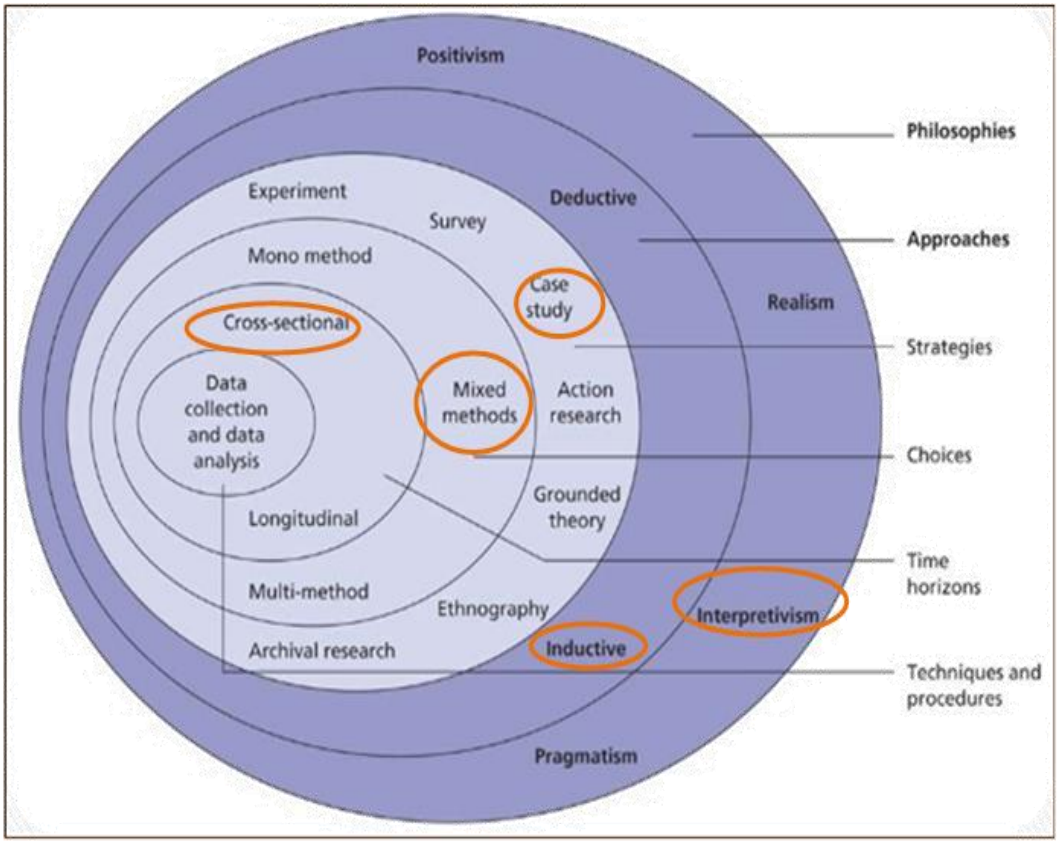


Figure 1-3. The Research Onion (Saunders et al, 2009; modified by the author encompassing this research choice)

1.5.1 The research philosophy

Research philosophy is referred to as a theoretical perspective, which has been defined as "the philosophical stance informing the methodology and thus providing a context for the process and grounding its logic and criteria" (Crotty, 1998, p. 3). Saunders *et al* (2009) expanded the definition: 'It contains important assumptions about the way in which you view the world. These assumptions will underpin your research strategy and the methods you chose as part of that strategy' (p. 108). Both explanations agree on the concept of building the research on stable ground to justify the selected research methodology.

According to Muller (2013), the efficiency of the system's performance is highly related to human interaction and can be built on social science research. Therefore, this research utilises the interpretivism philosophy to provide insight about the gamification design. Available definitions agree that the research will evolve through multiple findings to provide sufficient clarification regarding the investigated phenomena. Furthermore, Petty *et al* (2012) explain the role of the participants as active, and the researcher as joining the research context. As a result, the data collected will be analysed and interpreted based on insights from the researcher's perspective (Crotty, 1998; Saunders & Tosey, 2013; Creswell, 2014).

This research will follow an interpretivism philosophy that focuses on providing an understanding of the research topic or a certain phenomenon (Goldkuhl, 2012; Creswell, 2014). According to Saunders and Tosey (2013) and Creswell (2014), interpretivism focuses on the participants rather than the variables and depends on the participants' responses. Therefore, the aim is to provide an understanding of an issue of interest in a subjectivist manner (Goldkuhl, 2012). "The core idea of interpretivism is to work with the subjective meanings already there in the social world; that is to acknowledge their existence, to reconstruct them, to understand them, to avoid distorting them, to use them as building-blocks in theorizing" (Goldkuhl, 2012, p. 138). According to Petty *et al* (2012) and Creswell (2014), the term interpretivism can be used interchangeably with constructivism. The interpretivism philosophy is applied to provide insight and in-depth understanding of the gamification design, and the interaction between game developers and teachers. As for the approach, this research adopts an inductive approach to provide a flexible research design.

The use of gamification in an educational context is relatively new, as discussed in Chapter 2 Section 2.6, so the literature search retrieved articles published over the last decade. Furthermore, the use of underpinning theories was limited, which indicates the need for more understanding of the research area, as discussed in Chapter 2, Section 2.7. The foregoing discussion indicates the suitability of interpretivism for this research. As for the research approach, the inductive approach is in the same spectrum of the interpretivism philosophy that provides a deep understanding of the investigated issue with a flexible structure, as illustrated in Figure 1-3 (Saunders *et al*, 2009).

1.6 Research methodology

There are three possible research designs available: quantitative, qualitative and mixed methods:

A. *Quantitative research* is used to test a hypothesis, based on theories, using established measurements (Creswell, 2014; Byrne, 2017). The researcher is objective and has no impact on the data gathered (Petty *et al*, 2012). Although the research design used in the present study is related to qualitative methods, the use of a survey was applied as part of a mixed-method design.
B. *Qualitative research*, usually, is aligned with an interpretivism research philosophy (Remenyi, 2012; Saunders & Tosey, 2013; Byrne, 2017). The aim of adopting a qualitative design is to explore phenomena through participants' opinions and perspectives (Byrne, 2017). The researcher role in qualitative work is crucial to interpret the data and draw the conclusion that captures the knowledge of investigated phenomena (Creswell, 2014). In the present study, the qualitative methods used include interviews, think aloud interviews and thematic analysis.

C. *Mixed-method research* combines qualitative and quantitative methods (Saunders & Tosey, 2013). Vandercruysse *et al* (2012) emphasise the importance of mixing both qualitative and quantitative methods to gain valuable results for research projects. Another benefit, noted by Creswell (2014), is that each data set can validate or be incorporated to support the research purpose. Using mixed methods will allow the researcher to confirm or contradict the findings, which may enlighten the research discussion (Feilzer, 2010).

The research starts by using a quantitative approach (survey) to build a solid ground, and is followed with qualitative approaches (semi-structured interviews, think aloud interviews, thematic analysis and a focus group) to provide more clarification and an in-depth interpretation of the research phenomena. The sequence of the quantitative–qualitative approach is referred to as an 'explanatory mixed-method' (Creswell, 2014).

1.6.1 Survey

A survey is a quantitative tool described as 'a well-defined and well-written set of questions to which an individual is asked to respond' (Lazar *et al*, 2010). The benefits of choosing this method is that it provides a large sample of responses in a timely and budget-friendly manner (Bryman & Bell, 2007; Lazar *et al*, 2010). According to Saunders *et al* (2009), a survey is used in research of a descriptive nature. In developing survey questions, there are two types of questions: open-ended and closed-ended. Closed-ended questions provide pre-determined answers to the questions where the respondent might need to categorise, rank, choose from a list or simply confirm or negate a statement (Lazar *et al*, 2010). Open-ended questions give the respondent space to answer the question in their own words. They are useful in providing a deep understanding and insights regarding some aspects of the research that interest the researcher. The questions used in the survey are a mixture of both open-ended and closed-ended options. At the early stage of this research, survey data were used to refine the framework by categorising the components, as discussed in Chapter 4.

1.6.2 Interview

According to Bryman and Bell (2007) the interview is a technique of obtaining information from participants that falls under the qualitative paradigm. The interview is useful to provide a thorough understanding of a research topic and to allow the researcher to clarify and ask for explanation regarding a participant's response (Lazar *et al*, 2010; Muller, 2013). An interview could be conducted face to face, by telephone or via the internet (Creswell, 2014).

There are three types of interviews: structured, unstructured and semi-structured (Lazar *et al*, 2010). Structured interviews follow an interview guide where the questions are listed, and the researcher needs to keep the interviews in the same format for all participants (Bryman & Bell, 2007). In contrast, unstructured approaches have more space for the interviewee to express their

opinions or stories in a less constructed way (Lazar *et al*, 2010). According to Bryman and Bell (2007), while a list of questions related to the research issues is present, the interviewer does not need to strictly address all of them—they could use some and find an interesting correlation that needs more investigation. During the interview, the researcher could improvise in a way that suits the interviewee. In addition, interviews do not need to be conducted in the same form for all participants, and the questions do not necessarily follow a particular order.

Between the two styles, there is the semi-structured interview, where the researcher has a list of questions to be answered, however, they can initiate follow-up questions freely to obtain clarification or reasons for a particular response. Semi-structured interviews provide an in-depth understanding of the research topic and allow the researcher to prompt the participant with questions when more explanation or justification is needed (Lazar *et al*, 2010). In addition, the semi-structured interview is related to exploratory and explanatory research (Saunders *et al*, 2009). Therefore, semi-structured interviews were utilised in all data collection stages covered here in Chapters 4–7, sometimes as a pilot study held prior to the survey or the interviews.

1.6.3 Think aloud interview protocol

Think aloud is an interview protocol where interviewees are asked a question and encouraged to express their ideas about a certain issue (Charters, 2003; Norman, 2017). The researcher needs to pay attention to the moments of stress about the issue discussed and prompt the respondent with questions about their feeling regarding that moment. A limited explanation for think aloud (see Dix *et al*, 2004; Lazar *et al*, 2010) refers to this method as a usability test—a type of observation in which users express their thoughts while testing the interfaces. Both perspectives agree that the interviewer should pay attention to the participants' feelings and encourage them to speak and provide information regarding the investigated issue. Andrade and Law (2018) used think aloud as a mixed-method research tool (Charters, 2003). The additional observation by the researcher in the think aloud protocol provides triangulation for the data; this concept is discussed further in Section 1.8. This method is being used as an interview protocol in more studies in different fields, such as the public health sector (O'Hara *et al*, 2017), nursing (Johnsen *et al*, 2016) and education (Charters, 2003). In the present research, it is used as an interview protocol to interpret the outcomes of the survey and provide an in-depth view of the practicality of the proposed framework, discussed in detail in Chapter 5.

1.6.4 Thematic analysis

The benefits of using thematic analysis are that it allows the researcher to identify similarities across participants in a dataset and inform the guidelines and structure of the research (Braun & Clarke, 2006). Creswell (2014) provided general qualitative analysis steps, similar to those offered by Boyatzis (1998), as thematic analysis. Boyatzis (1998), Braun and Clarke (2006), and Creswell (2014)

suggested different steps for thematic analysis, emphasising the importance of looking through the data to construct a theme. To summarise their steps, the process of thematic analysis is outlined as follows:

- Organising and reviewing the data.
- Finding a repeated segment in the data set and labelling it as a code(s).
- Following the same code across participants and examining the change to provide an enriching description of the code.
- Looking for a theme(s) through the code's description; providing every theme with a name and capacity.
- Interpreting the findings from the theme(s) to provide an understanding of the investigated phenomena.

Boyatzis (1998) describes three approaches for thematic analysis:

- Theory-driven,
- Prior-research-driven, and
- Developing code inductively.

Guest *et al* (2012) describe two approaches:

- Exploratory, or content driven, and
- Confirmatory, which is hypothesis driven.

Both Boyatzis (1998) and Guest *et al* (2012) agree that the code and the analysis should be considered early, but with different levels of preparedness—one is built prior to data collection, while the other is designed upon data collection.

When themes are constructed prior to the data collection, codes are used to predict that the results will fall into a certain category or to confirm prior knowledge or negate a certain fact. Boyatzis (1998) states the approach is either theory-driven and prior-research-driven, while Guest *et al* (2012) referred to the approach as confirmatory.

Themes can also build upon data collection. In this scenario, the codes are not predetermined, and the researcher needs to develop the themes inductively based on the available dataset (Boyatzis, 1998). Along similar lines, Guest *et al* (2012) refer to this type as content-driven and using an exploratory approach.

According to the literature review conducted in Chapter 2, there is no theory that supports the idea of gamified learning focusing on either the interaction of teachers and game developers or teachers' attitudes towards participating in the design. In addition, there is a lack of themes

regarding the investigated issue of this research. Therefore, this research will follow the exploratory approach, which involves building themes upon data collection inductively.

1.7 Sampling and participants

This section discusses the general outline that is followed in the quantitative (survey) and qualitative (interview and think aloud interview) parts of the research. A more detailed discussion is provided in each chapter to explain specific participant criteria.

For the survey, the research followed a snowball sampling technique to reach as many participants as possible, with a suggested total of either 68, or of 45 as suggested by Schulz *et al* (2015), as discussed in Chapter 4, Section 4.5.3. Bryman and Bell (2007) explained the technique where the researcher contacts a small group of participants and asks this group to provide more participants through their contacts. Blanche *et al* (2006) acknowledged the benefits of this sampling technique for qualitative research to provide an in-depth understanding. Bryman and Bell (2007) argued the validity of non-probability sampling in generalising the results; however, research respondents ranged in experience from less than 1 year up to 30 years. Collis and Hussey (2009) argued that research based on an interpretivism philosophy, as is utilized in the present study, is more likely to use a small sample. Furthermore, Saunders *et al* (2009) agree that non-probability sampling (such as snowball sampling) is practical in the early stages of research.

As for the interviews and think aloud interviews, the research uses a small sample per the guidance from Saunders and Tosey (2013) who argue that it is suitable for research following an interpretivism philosophy to provide deep insight into the investigated area. Also, conducting qualitative research with a small sample allows for comprehensive theoretical insights (Saunders *et al*, 2009). The sampling technique referred to as convenience sampling has been found to be acceptable when the group is representative (Bryman & Bell, 2007). Silverman (2013) emphasised that, in qualitative research, an interview utilises open-ended questions offered to a limited number of participants; Lazar *et al* (2009) suggest that five is a 'sufficient number of participants'. For example, a study of approaches to designing multimedia for mobile learning used a sample of five participants (Nagro & Campion, 2017). According to Nielsen (1993), five participants is an ideal number for interviews, and focus groups can be conducted with a range of 6–9 participants. Chapters 5–7 describe the qualitative approach of the present study and discuss in detail the participants' diversity.

1.8 Validation and triangulation

From a general perspective, validity in qualitative research is the process of checking that the information provided in the findings are correctly represented by the researcher (Creswell, 2014). The validation process in this research ensures that the framework and the Ped-GDD are enabling

communicating the pedagogical requirements of the game between the teachers and game developers. The validation of the proposed framework is a fulfilment of the aim of promoting synergy between teachers and game developers, which is outlined in Chapters 4,5 and 6. Validity can be improved through the following:

- Using a mixed method, where the survey findings are followed by interviews (see Chapter 5) to validate the findings and provide rich information.
- The use of think aloud protocol in the interviews, which provides observation as another data source, referred to as triangulation (Remenyi, 2012).
- The use of current literature to cross-reference the themes found in the interviews' analyses, which were part of the validation (see Chapters 5 and 6).

Triangulation, in this context, means finding a different source that has examined the information and supports the justification or the research outcome. This can be particularly useful in the process of consolidating the themes that have been partially examined in other resources (Creswell, 2014). Saunders *et al* (2009) refer to triangulation as the use of multiple data collection methods to authenticate the information processed from the data. Remenyi (2012) suggests using triangulation to study the same subject from different angles to provide a deep understanding of the subject. This could be achieved through obtaining the data through multiple methods, including interviews and observation, or supporting the interview information with documents. In the present study, triangulation was completed in the following ways:

- Triangulation through interviewing a different group of teachers (Chapter 4 and Chapter 5).
- The findings were validated by another group of domain experts—game developers (Chapter 6).
- Using a deep description in the analysis of the themes to explain possible relationships and possible meaning (Creswell, 2014), which is presented in Chapter 5.
- External auditing that requires a person outside the research to review the research process and findings and provide feedback (Creswell, 2014). In this research, the primary data collection chapters were published in conference proceedings, and the reviewers' feedback was taken into consideration in building the following research steps.

1.9 Evaluation

Beecham *et al* (2005) used the terms 'validation' and 'evaluation' interchangeably in their case study; however, their process relates to the evaluation intended in this research. They explain the experts' evaluations as the process of ensuring a model is satisfying its intended goal. Persico *et al* (2014) refer to the evaluation as the acceptance and adoption of the system. The evaluation could

be achieved through the Technology Acceptance Model (TAM) (Sánchez-Prieto *et al*, 2016; Alharbi, 2017; and Alyami, 2017). According to Sánchez-Prieto *et al* (2016), TAM elements originally follow the theory of reason and action, which includes: attitude, subjective norm, behavioural intention and behaviour. Nonetheless, TAM has been customised over time to accommodate different research purposes. For example, Sánchez-Prieto *et al* (2016) apply it to perceived usefulness, perceived ease of use, attitude towards the use, and external variables. The evaluation of the proposed framework is discussed in Chapter 7.

The number of participants in an evaluation process has been discussed in the literature. For instance, Lazar *et al* (2010) refer to five participants as a sufficient number in HCI. According to Nielsen (1993), the number of participants for think aloud interviews should be between three and five. Nielsen (1993) suggests using five participants in interviews when they have diverse expertise. Likewise, scholars have shown that relying on five participants would identify up to 80% of the usability issues in the interface, and including more than ten participants would lead to the same issues being identified repeatedly (Nielsen & Molich, 1990). According to Nielsen (2000), the number of identified usability issues would remain the same even if the participants' number increases, as illustrated by the flattened curve in Figure 1-4. The evaluation process represents the end user's acceptance of the Ped-GDD as a research outcome outlined in Chapter 7. The evaluation measures how intuitive and how likely the proposed framework would be used in a school environment for educational purposes.

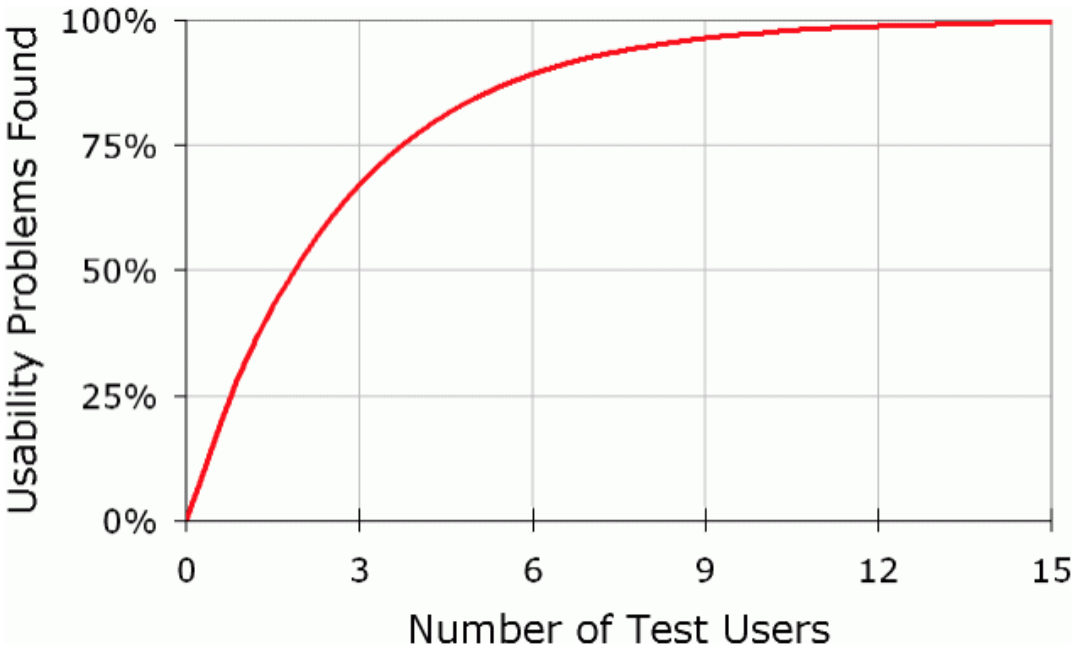


Figure 1-4. The Relationship between the Number of Participants and the Usability Problems Found (Nielsen, 2000)

1.10 Ethical considerations

Staffordshire University's code of ethics was followed throughout the research process. The research has multiple stages of data collection, and the ethical approval and can be found in Appendix A. The interviews were conducted with teachers and game developers, and in all cases, the ethical process approved by the Staffordshire Ethical Committee was followed. On the cover of the questionnaire and interviews, the participants were provided an information sheet to explain the research intention and purpose; they were also notified of the voluntary and confidential nature of their participation and were informed they have the right to withdraw at any time. The data are being stored securely following the procedures of Staffordshire University.

1.11 Thesis outline

The research outline follows Dunleavy (2003), who suggested three sections: lead-in, core, and lead-out. The lead-in section includes Chapters 1 and 2. The core section includes Chapters 3–7. Finally, the lead-out is discussed in Chapter 8.

Chapter 1 discusses the background and motivation behind this research. In addition, the chapter emphasises the significance of gamification in a learning context and states the aim and objectives of this research. The chapter describes the choices made conducting this research regarding philosophy, approaches, and tools.

Chapter 2 discusses the literature review that was conducted and covers a review of the gamification concept and the benefits of using games for students. Then, the chapter describes an

extensive search for teachers' roles as key stakeholders in gamification design, and reviews existing gamification design frameworks used in the educational context to explore current practices and find the barriers and challenges that hinder teachers' integration into the design process.

Chapter 3 discusses the process of developing a framework that provides a high-level view together with the steps to support teachers in developing games. The outcome is an AH-GPD Framework, Version 1. The high-level framework is built based on two software design models: Analysis, Design, Development, Implementation, and Evaluation (ADDIE), and Usability-Software Development Life Cycle model (U-SDLC). Finally, this chapter explains how the gamification elements in relation to learning were identified.

Chapter 4 outlines the validation of the AH-GPD framework with schoolteachers. This chapter mainly focuses on the teacher's role in the design process using a quantitative approach, which resulted in Version 2 of the framework.

Chapter 5 reviews the practical validation of the gamification elements utilising a qualitative approach. The outcome of this chapter is the development of Version 3 of the AH-GPD framework, which identifies sub-elements that support the framework's practicality for teachers.

Chapter 6 presents the validation of the proposed framework with the game developers, the other collaborating domain experts, to support the teachers in the educational game design of an AH-GPD framework. The aim of this chapter is to confirm the game developers' elements, including both the HCI and the gamification elements.

Chapter 7 discusses evaluating the Ped-GDD as a representation of the AH-GPD as a research outcome. The evaluation used a panel of experts that included both stakeholders (i.e. teachers and game developers). The criteria are adopted from the TAM for research purposes, and include six elements: easy to learn, easy to use, usefulness, comprehensiveness, adaptability, and Intention to use in the future.

Chapter 8 outlines the research findings and their contribution. It also summarises the research limitations and discusses potential research opportunities for future work.

Chapter 2. Literature Review

2.1 Introduction

The previous chapter discussed the research design and the thesis layout. This chapter provides the theoretical basis for the research as it relates to the literature. This consists of a review of the gamification concept, in which there appears to be a lack of clarity about the meaning provided in the literature. This chapter discusses the benefits of using games on students' engagement, learning acquisition, skills and resilience. Then, the chapter describes a focused search for teachers' roles as key stakeholders in gamification design. Finally, the chapter closes with a critical review of existing gamification design frameworks used in the educational context to explore current practices and find the barriers and challenges that hinder teachers' integration in the design process.

2.2 Context

This chapter explores the practices for gamification design and identifies the gap in the current research by recognising different contexts, as illustrated in Figure 2-1. This diagram is a visual aid to orientate the reader through the thesis — highlighting the research stage at the beginning of each chapter.

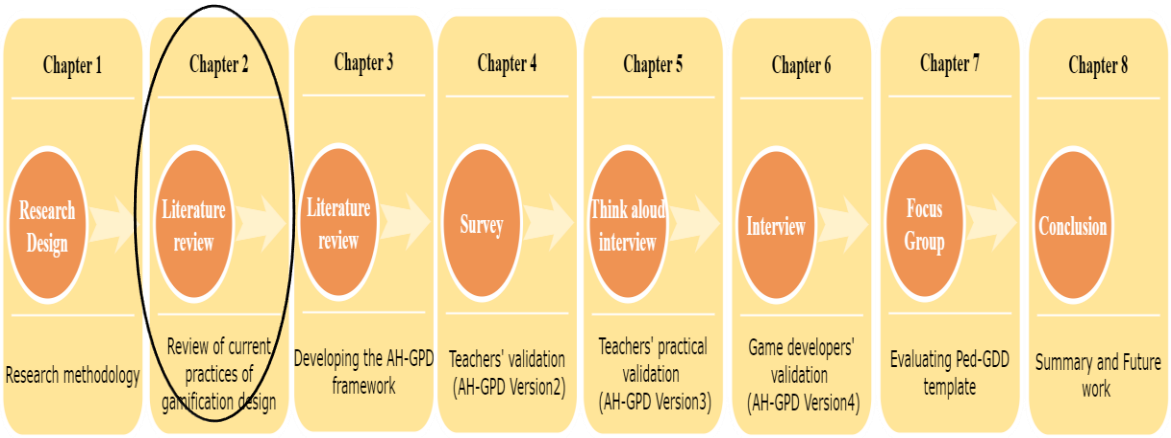


Figure 2-1. Chapter 2 in the Thesis Layout

First, it is necessary to identify gamification as a concept, and to acknowledge the interchangeable nature of the terms gamification, game-based learning and serious games. Additionally, the increased use of gamification in light of its positive impact on engagement to provide a better outcome in a learning setting is outlined in Section 2.4. The teacher's role is essential to adopt a gamified pedagogical design, as discussed in Section2.5. Furthermore, a thorough investigation of the literature is conducted to recognise the existing theories and frameworks in gamification design from a pedagogical context. By investigating the published work in gamification design in an educational context, three barriers have been identified. The first barrier is the frameworks that acknowledge the value of teachers' input; in other words, the role of the teacher and how their input can be applied in the gamification design process was unclear. Second, scenario-based

approaches that provide descriptive information present a challenge to extract the features of the gamification elements. Third, some frameworks present a high-level overview, which helps us to understand the design process. Nonetheless, teachers require more structured or outlined steps and guidance to support them in the design process. The current situation surrounding the COVID-19 lockdown has resulted in unprecedented measures, including school closures, that pose obstacles in pupils' learning paths. Using gamification presents an alternative to support home-schooling due to its positive effects and entertainment aspects. The current pause in conventional teaching has created an opportunity for stakeholders to take a step towards supporting gamification in an online format to bridge the emerged gulf and build a community that is willing to adapt to new approaches of learning.

Sellgren (2020) discusses the UK National Foundation for Educational Research (NFER) report, which indicates that one-third of students are not engaged in their learning tasks in the current home-schooling situation. The NFER chief executive emphasised that there must be a plan devised to overcome the lost learning time during the COVID-19 pandemic. One issue is the availability of technology or studying space, but what has not been clarified is whether the problem stems from access to an internet connection or to a PC to view the online learning material. Coughlan (2020) discusses the efforts to overcome internet availability by providing disadvantaged families with internet vouchers. Voucher distribution is based on an arrangement between British telecommunications company (BT) and the Department for Education.

2.3 Gamification

The term gamification has been introduced in different settings with some researchers taking a general focus, while others examine gamification from an educational perspective. Deterding *et al*. (2011) define gamification as "the use of game design elements in non-game contexts" (Mystakidis et al., 2014; Browne et al., 2014).

Markopoulos *et al*. (2016) acknowledge the use of games amongst diverse sectors (e.g. business, marketing, medicine, and military) to fulfil the learning purposes. The diverse gamification application is presented in Sánchez *et al.* (2020), which relates the concept of gamification to customer loyalty schemes in the business sector. According to Darejeh and Salim (2016), the popularity of gamification use amongst various software applications is growing.

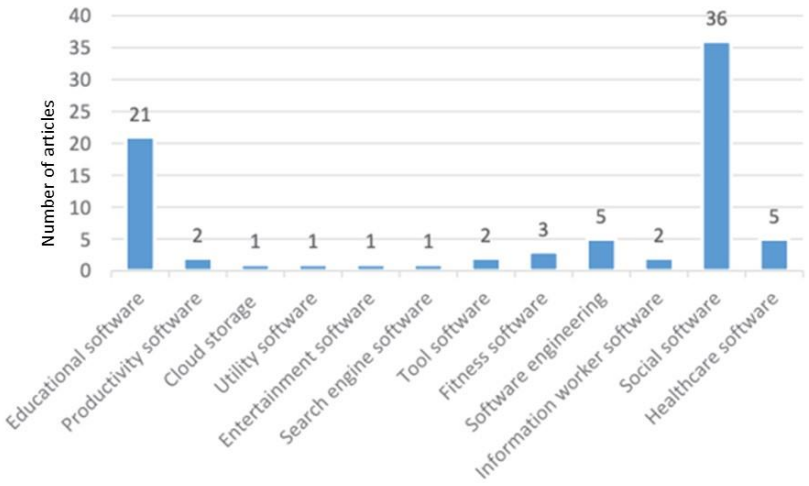


Figure 2-2. Context of Gamification Use (Darejeh & Salim, 2016, as modified by the author)

The terms gamification, game-based learning and serious games are often used interchangeably. Özdener (2017) discusses the confusion between 'gamification' and 'game-based learning' in academic publications. Gamification is considered to be a wide lens used to describe applying gaming mechanics in different contexts, while game-based learning focuses on the goal of education. Serious games are distinguished as a complete game designed to simulate certain experiences for learning purposes, while gamification involves applying game mechanics to a certain context (Browne et al., 2014; Alloghani et al., 2017; Ampatzidou et al., 2018).

De Santana et al. (2016), who addresses gamification from a student-centred perspective, define gamification as "the application of elements used in the development of video games, such as mechanics and dynamics in other contexts outside traditional games, to generate more enjoyable and positive attitudes from the students" (De Santana et al. 2016, p.911). Along similar lines, Botha et al. (2014) and Botha and Herselman (2015) distinguish the concept of "Educational Gamification" as the design strategy of using game design elements in educational contexts to support teaching and learning goals. Rogers (2014) considered applying game mechanics to support learning as the educational game genre 'edutainment'; however, the term is not widely used. According to Andrade and Law (2018) and Hill and Brunvan (2018), the use of gamification in learning is gaining attention.

According to Darejeh and Salim (2016), the gamification concept has two levels: the structural level—where educational content remains unchanged when gamification elements are added, such as reward schemes—and the content level, where gamification will require a complete transformation of the content using more than one gamification aspect. However, most of the

reviewed frameworks in this research, discussed in Section 2.7, do not distinguish between the two types. In this research, the focus is to gamify the educational content to enhance the learning experience.

According to Simões et al. (2013), gamification has been introduced since 2010; however, there was a lack of consistency and clarity about the meaning (Deterding et al., 2011). There are different definitions of the term gamification; however, a widely accepted view emphasises gamification as the application of game mechanics and elements into a non-gaming context.

2.4 Gamification benefits

Published work has emphasised the positive impact of gamification on students' engagement and on the learning acquisition and improvement of their skills and resilience. This section discusses the significance of gamification, specifically in a learning context. Lameras and Moumoutzis (2015) discussed the increased popularity of commercial social platforms due to incorporating gamification, which was an encouraging factor to consider gamification to promote learning. Sánchez *et al*. (2020) discussed the advantages of gamification use in a learning context, such as promoting engagement, providing encouragement for challenges, improving skills and enhancing students' learning acquisition.

Dumitrache and Almăşan (2014) studied the educational value of computer games by comparing existing studies in the field and emphasised the impact of such an environment to help build psychological resilience. Lai *et al*. (2014) investigated the 'social network games learning system' with 98 candidates studying an operating systems course. The game story took place on a deserted island, involved caring for pets and raised morality concepts. The students' motivation towards learning was shown to increase; however, the researchers noticed that, after a while, pupils found the game tedious and suggested that developers invoke excitement through allowing them to contact each other within the game.

Mystakidis *et al*. (2014) aimed to promote reliance on books and encourage reading as a habit among young students at schools using a game to introduce children to the library and including storytelling in the design. Of the teachers who evaluated the study, 85% noticed that students who participated had a better attitude and enthusiasm towards reading activities. Another positive effect is discussed in Halloluwa *et al*. (2016), where students established better social communication and started helping each other to progress through the game. "The teacher-centric learning shifted into a balanced mix of student-centric learning where students took the ownership of their learning through technology" (Halloluwa et al., 2016, p.4). Similarly, Tolentino (2019) experimented on using gamification in a physics course, and the findings suggested a positive impact on students, both in learning acquisition and motivation. In terms of a different aspect of

learning, a study by Fitz-Walter *et al*. (2017) used a gamification 'Application' to teach driving and users found improved engagement and enjoyment.

Some studies followed a comparative approach to investigate the difference between gamification and traditional learning. For example, Martín-Sanjosé *et al*. (2015) divided participants into three groups: games with a group, games in pairs and traditional learning. The study concludes that using games demonstrated a better effect on students' learning acquisition, whether in groups or pairs. Another comparative experiment, conducted with university students concluded that gamification increases students' engagement (Naik & Kamat, 2015). Similarly, Lo and Hew (2018) studied three learning groups: traditional, gamified flipped learning and an online class. The students' test score averages were 18, 22 and 17, respectively. The gamification group scores were higher than the other groups, which demonstrates the positive effect of gamification on students' knowledge acquisition.

The foregoing discussion provides confirmatory evidence of the beneficial impact of gamification on students' motivation.

2.4.1 Motivation in gamification

There are two types of motivation related to gamification discussed in the literature; extrinsic and intrinsic. Chou (2016) explained that extrinsic motivation could be applied through rewards such as points and achievement symbols. Nonetheless, rewards of this type will not provide the necessary intrinsic motivation to progress through a game. Mekler *et al.* (2017b) identify the lack of comprehensive studies that evaluate the extrinsic motivation such as rewards and leaderboards in relation to user experience. Another concern that some reward techniques have a demotivating impact such as leaderboard and players ranking list. The concern is raised by Goshevski *et al*. (2017) that Leaderboard might demotivate students who are not progressing well. Chou (2016) argues that this technique would discourage players if not implemented carefully. A possible solution is appropriate implementation in three-steps; firstly, place the player in the middle of the list to encourage them to excel more. Secondly, setting groups where peer pressure would encourage all team members to try their best to upgrade the team's position on the leaderboard. Finally, keep the leaderboard updated all the time to reflect progression/ update the leaderboard instantly (Chou, 2016). Also, Pineda-Corcho and Moreno-Cadavid (2017) suggested a way to prevent the ranking from disappointed players by inventing groups to has their own ranking beside the overall player rank.

Sailer *et al*. (2017) identifies badges and points as a gamification element that fulfils a sense of competency providing feedback to players. Badges with leaderboard as a group were studied as of elements and concluded that competency which is reflected in their experiment findings as the feedback provided to players satisfies the competency— as well as enhance the meaningful of the

learning task. Also, Bellotti *et al*. (2013) advised that the use of extrinsic motivation would promote the engagement; nonetheless, teachers must draw the students' attention to the educational value. Goshevski *et al*. (2017) share the same premise, describing the game elements; there are two types of gamification; reward-based and meaningful. The reward-based could utilise any type of rewards as extrinsic motivation (e.g. points, badges, leaderboard. The meaningful gamification is about sustaining an intrinsic motivation for the learner.

The aim of pedagogical gamification should be promoting intrinsic motivation through game design. The game design has to consider the progression presentation to the players s, i.e. players should be aware of their accomplishment, challenges they overcome and the standing barriers. As Reng and Schoenau-Fog (2016) agree on emphasising the need for adding an individual's sense of accomplishment besides rewards positive effect—extrinsic motivation.

2.5 Teachers' contribution in gamification design

This section discusses the role of teachers as key collaborators in adopting and implementing gamification as a new learning technique.

In one case, a class of 30 students in Year 11 in a Cardiff high school achieved a grade of A^+ in maths at General Certificate of Secondary Education (GSCE), a phenomenal success for all individuals (BBC Wales, 2020). This school is a public school located in a middle-income area of Cardiff, reflecting socio-economic influences. This provides a real-life experience worth studying and analysing. According to the head teacher, the students were confident in their ability to excel in the examination. The instructor, Mr Elive, is known as 'the maths whisperer' and has been responsible for teaching the same group through their high school years (BBC Wales, 2020). This evidence emphasises teachers' effects on students' learning acquisition and, therefore, the importance of teachers' roles in designing pedagogical gamified material. The teachers contributed to the gamification design by bringing their experience to a collaborative project with game developers. The goal of collaborating with such gifted teachers was to break down the learning material and include the motivational aspect for students.

Other examples offer similar findings, Gunter *et al*. (2006) acknowledged that merging games into education without consolidating learning theories would lead to a poor experience and will not achieve learning goals. Lameras and Moumoutzis (2015) emphasised the teacher's role in developing new technologies in their teaching plans and recognised the challenge of game design. Therefore, there is a need to support teachers in integrating games as a teaching tool. Along similar lines, González *et al*. (2016) referred to teachers' and schools' roles as essential for behavioural change, therefore, integrating them in the design team for the game is crucial. Finally, Kayımbaşıoğlu *et al.* (2016) emphasise the importance of outlining gamified educational content and how teachers' integration of the design process is a rising research interest in education.

Building on this work, a study by Eriksson (2015) developed a master's degree of IT curriculum that included the topic of Interaction Design and Children (IDC). The findings suggest that people with computer expertise are not necessarily capable of building educational activities for young students. Hamari and Nousiainen (2015) referred to teachers in the design process as co-creators of the content. Similarly, Kapp (2012) emphasised the role of subject experts in a design team to outline the educational objectives of an educational game. Also, Kermek et al. (2016) discussed the interdisciplinary nature of gamification in an e-learning environment, which requires collaboration amongst different specialities, including education, IT specialists, psychology and pedagogy. This discussion puts forward the idea that teachers' input is as essential as technical experts' game programming skills. Finally, Hamari and Nousiainen (2015) surveyed 1,668 teachers and emphasise that teachers' perspectives and enthusiasm affect their adoption of games as a teaching tool. The study findings confirmed the positive influence of having a supportive social environment for the teachers.

The evidence from the literature shows that, while the importance of the teacher's role is acknowledged, it has not been sufficiently investigated. This research promotes collaboration by merging the expertise of teachers and game developers to support a 'gamified pedagogical design'. Some researchers have acknowledged the complexity of gamification design (Lai et al., 2014; Fitz-Walter et al., 2017), while others identify it as a time-consuming task (Tolentino, 2019), which is in line with the research findings discussed in Chapter 4, Section 4.4.2. Therefore, this research aims to provide an intuitive framework that supports teachers' integration of gamification by applying game elements, to avoid the disadvantage of the time-consuming process.

2.6 Literature review of gamification design frameworks in a learning context

The literature review conducted to investigate gamification use in the learning sector examines the existing design framework and investigates the support provided to teachers as key facilitators for pedagogical utilisation of gamification. The search was conducted in two phases. First, the search was performed as part of the Research Degree Committee 2 (RDC 2) report in 2017 that retrieved 87 articles; this was part of the process of the transfer of registration from MPhil to the PhD stage at Staffordshire University. Then, an updated literature review was conducted in May 2020 and retrieved 38 articles, as outlined in Table 2-1. Both searches focused on gamification as a concept and its use in learning together with investigating the existing design approaches to find the teachers' roles.

Table 2-1. Search Criteria for Initial and Updated Literature Review, 2017 and 2020

Year	Search engine	Number of retrieved articles	Search criteria
2017	ACM	13	(gamification+and+learning) AND recordAbstract:(+teacher+educator)
	IEEE	29	
	Science Direct	45	
Initial literature review articles		87	
2020	Scopus	38	(TITLE-ABS-KEY (gamifi* AND learning AND teacher AND design)) AND (motivation)
Total		125	
Key: TITLE-ABS-KEY indicates Title-Abstract-Keywords			

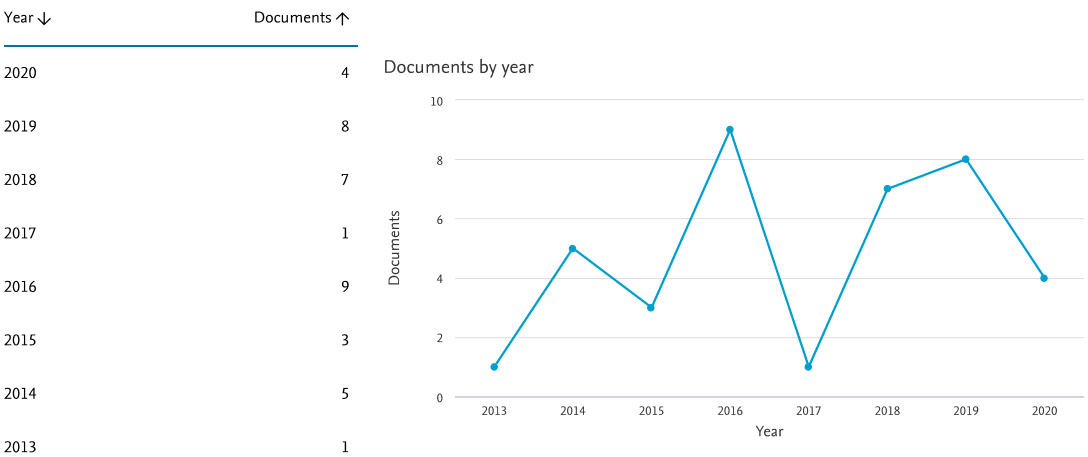
The initial literature review conducted in 2017 included three databases: IEEE, Association for Computing Machinery (ACM) and Science Direct. The search was carried out individually for each database following the same search criteria. All three databases returned 87 documents, as outlined in Table 2-1. The inclusion criteria encompass the gamification design method in the context of learning, theoretical studies or proposals supported by an experiment, as well as teachers or students integrated as part of the process. The exclusion criteria encompassed gamification applications in fields other than computing and learning or education. This is in addition to papers not written in English, which resulted in 87 related articles.

In May 2020 during the writing up of this thesis, an updated literature review was performed utilising Scopus, an indexing database for peer-reviewed resources covering 5,000 publishers that includes all the publishers used in the initial search. A modified criteria was applied using the word 'motivation' which was added to the list of search terms, as outlined in Table 2-1. The search was conducted following the steps outlined in Figure 2-3, stating the number of retrieved articles after every addition to the search criteria. As illustrated in Figure 2-3, the keyword 'motivation' was added because, in the initial review, some articles discussed individual gamification elements without evidence of the effects and in light of this research focus on using games to enhance learning. The addition of the term was to emphasise the inclusion of motivation for all parties involved, teacher or students. Furthermore, the research excluded conference reviews, which are opinion-based reviews of a conference outline or organisers. Six (6) articles from the initial search in 2017 are the same retrieved in the 38 from the updated search in 2020. As the literature search

criteria was updated post conducting the primary research therefore, resulted in explicit recapture of related articles.

Figure 2-3. The Refining Process for Search Result Terms and Number of Retrieved Articles

Scopus (2019) has built-in tools to analyse the retrieved data, and Figure 2-4 visualises the findings of the literature search. Interestingly, the search did not apply date restrictions; however, the range of publications started in 2013, as illustrated in Figure 2-4. This indicates that it is a new research area and the contribution to knowledge is promoting a rising interest in the research scope.



Year ↓	Documents ↑
2020	4
2019	8
2018	7
2017	1
2016	9
2015	3
2014	5
2013	1

Figure 2-4. The Distribution of Publications through the Years

The search indicated that Saudi Arabia has a limited publication history, producing only 1 article out of 38, as illustrated in Figure 2-5 (Mystakidis & Berki, 2018). The reference to Saudi Arabia is to

indicate an author affiliation and not in reference to the participants included in the research. Nonetheless, this indicates that the research area is under-explored in Saudi Arabia, which shows a context gap.

The Saudi Arabian 2030 Vision features 13 vision realisation programmes, including the Human Capital Development Program. The development scheme aims to improve the educational outcomes for citizens of all ages by teaching skills to face challenges and learn emerging technologies while managing rapidly changing experience requirements. The government vision is to extend the education system for children by building an empowered citizen character (Council of Economic and Development Affairs, 2016). As learning becomes an essential part of the Saudi Arabian government plan, there is a need to build a framework based on research to avoid exhausting financial and human resources without achieving guaranteed results. As gamification research confirms the beneficial effect on learners' motivation, Saudi Arabia needs to adapt gamification as one of the approaches to engage young citizens to learn at an early stage. Therefore, there is a need to build a framework that involves different stakeholders to encourage children in pursuing education.

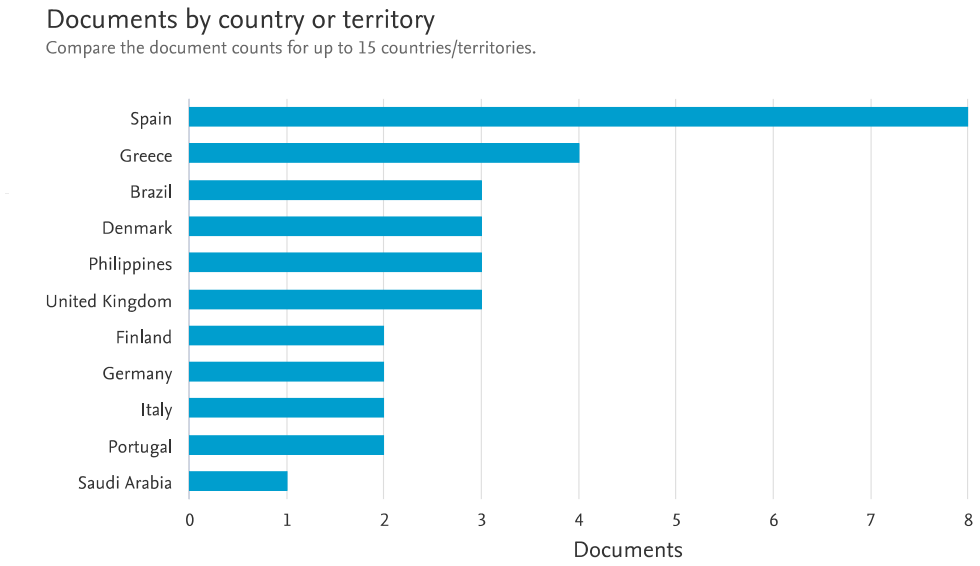


Figure 2-5. Publication Classification Across Countries

Figure 2-6 illustrates the intersection of gamification as a topic with different subject areas (e.g. Social Science, Engineering, Art, etc.). Therefore, there is a need for a design tool to communicate the requirement in a simple format that caters to users of diverse backgrounds.

Subject area ↓	Documents ↓
Computer Science	38
Social Sciences	17
Engineering	10
Arts and Humanities	2
Mathematics	2
Neuroscience	2
Psychology	2
Decision Sciences	1

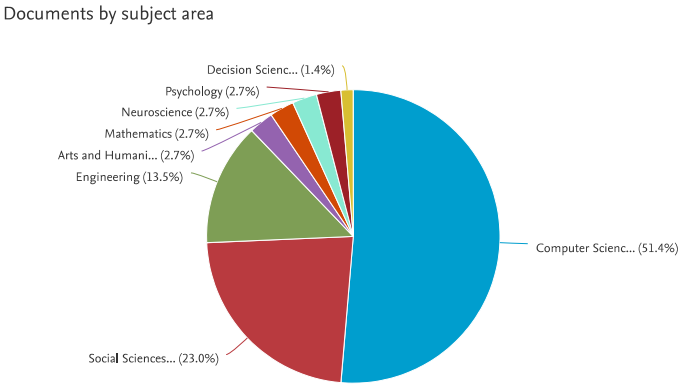


Figure 2-6. Classification of Articles According to Subject Area

Although the Scopus database indexed the publication abstracts, most of the articles were not available through Scopus, and the articles were retrieved from the publishers, such as IEEE, Springer, ACM, and others; the exception was three articles that could not be accessed.

The articles were examined systematically to identify gaps in the literature review. A sample of the literature review analysis sheet can be found in Appendix B.

One of the features provided in Scopus is to document the number of citations of the retrieved articles; Table 2-1 outlines the three most-cited articles in descending order. First, Cózar-Gutiérrez and Sáez-López's (2016) research has been cited 32 times. Their paper discusses the experiment conducted with university students who are studying for a career as primary teachers. Interestingly, the paper has no games-related design steps. The second-highest-cited paper is Melero et al. (2015); this study provides an example of teachers' design utilising some gamification elements, which is one of the most related frameworks and will be discussed further in Section 2.8.2. Dodero *et al*. (2014) is the third-place publication and has gamification design with pedagogical considerations, which is discussed in Section 2.8. The high citation numbers for articles with gamification design frameworks demonstrates the significance of this research.

Table 2-2. Number of Frequently Cited References

Reference	Number of citations
Cózar-Gutiérrez & Sáez-López (2016)	32
Melero et al. (2015)	30
Dodero et al. (2014)	24

2.7 Underpinning theories

In the literature review setting discussed in Section 2.6, the use of underpinning theory in the design process was limited to de Oliveira and Santos (2016) and Lo and Hew (2018). De Oliveira and Santos (2016) discuss the use of games as part of the learning plan and the process of building the game in accordance with 'constructivist theories'. Although theories were mentioned as plural in the text, the discussion did not identify a specific theory. Therefore, they rely on theories indicating the authors' understanding of the foundational concepts, as there is no discussion of any theory or its applicability in the design process.

In contrast, Lo and Hew (2018) build their research using self-determination theory, which focuses on an individual's motivation. According to Kapp (2012), self-determination theory consists of three components: autonomy, competence and relatedness. The components of the theory could be applied through many gamification elements; however, they only chose to apply feedback.

The extensive search of the literature in this thesis reflects a limited utilisation of underpinning theories to build frameworks, as only two references acknowledge theories (de Oliveira & Santos, 2016; Lo & Hew, 2018). Nonetheless, the discussion of the theories was found to be vague, and did not describe theory applications sufficiently.

However, there is other research in gamification that utilises theories such as assemblage theory. Banks (2014) used assemblage as a technique to analyse game components, which supports the programmer of large-scale designs. The concept is adopted from Taylor (2009), who wrote: 'The notion of assemblage is one way to help us understand the range of actors (system, technologies, player, body, community, company, legal structures, etc.), concepts, practices, and relations that make up the play moment' (2). Furthermore, Suter et al. (2019) described players' experience of a game as resembling 'technological assemblage', adopting DeLanda's (2006) perception of the assemblage theory that emphasises that interactions among entities give rise to new and unique characteristics, as well as grouped capacities that indicate how entities can affect or be affected. Although assemblage theory could support the interaction between teachers and game developers, it would still be a theoretical conceptualisation of the process. This research is looking for a practical solution. Consequently, the next step is to investigate existing design frameworks used by practitioners.

2.8 Existing gamification design frameworks

This section reviews 25 existing frameworks relevant to this research from the literature, as discussed in Section 2.6. The frameworks reviewed in this section discuss gamification design in a learning context or including pedagogical consideration either by including learning theory or having teachers intervene in the process. The following discussion follows a chronological order.

A research by Ibrahim and Jaafar (2009) proposes the Educational Game Design Model presented in Figure 2-7. The model is based on problem-solving technique and includes three elements; Game design Pedagogy and Learning content modelling. Although, pedagogical level and the curriculum objects are mentioned, the teachers' role was not clarified.

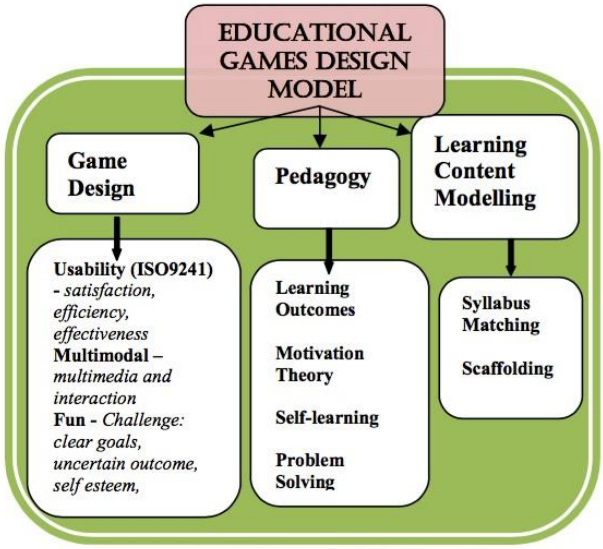


Figure 2-7. The Educational Game Design Model by (Ibrahim & Jaafar, 2009)

A Model of Educational Game Design by Ak (2012), presented in Figure 2-8, utilised Kolb's (1984) experiential learning cycle. The experiential learning has an adaptable nature that made it widely popular amongst researchers (Leong et al., 2019). The research emphasised the importance of users' needs and objectives as part of the early input phase, and the model suggested measuring both 'achievement' and 'motivation'. Additionally, it involved more usability and user experience in the process. While the research mentions objectives, there is no clear delegation of this task to teachers.

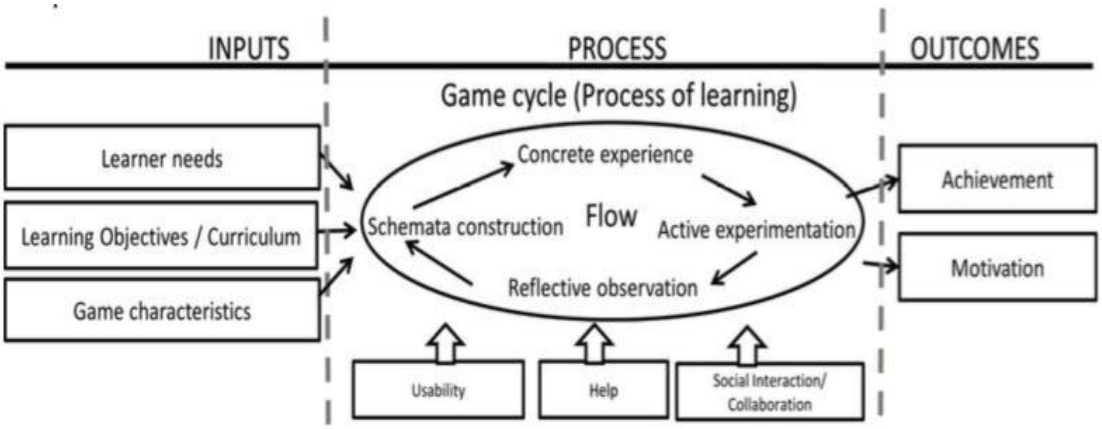


Figure 2-8. The Model of Educational Game Design (Ak, 2012)

Research conducted by Gaber et al. (2013) on generic virtual lab architecture, illustrated in Figure 2-9, describes the availability of multimedia in the platform as a 'game-like' experience.

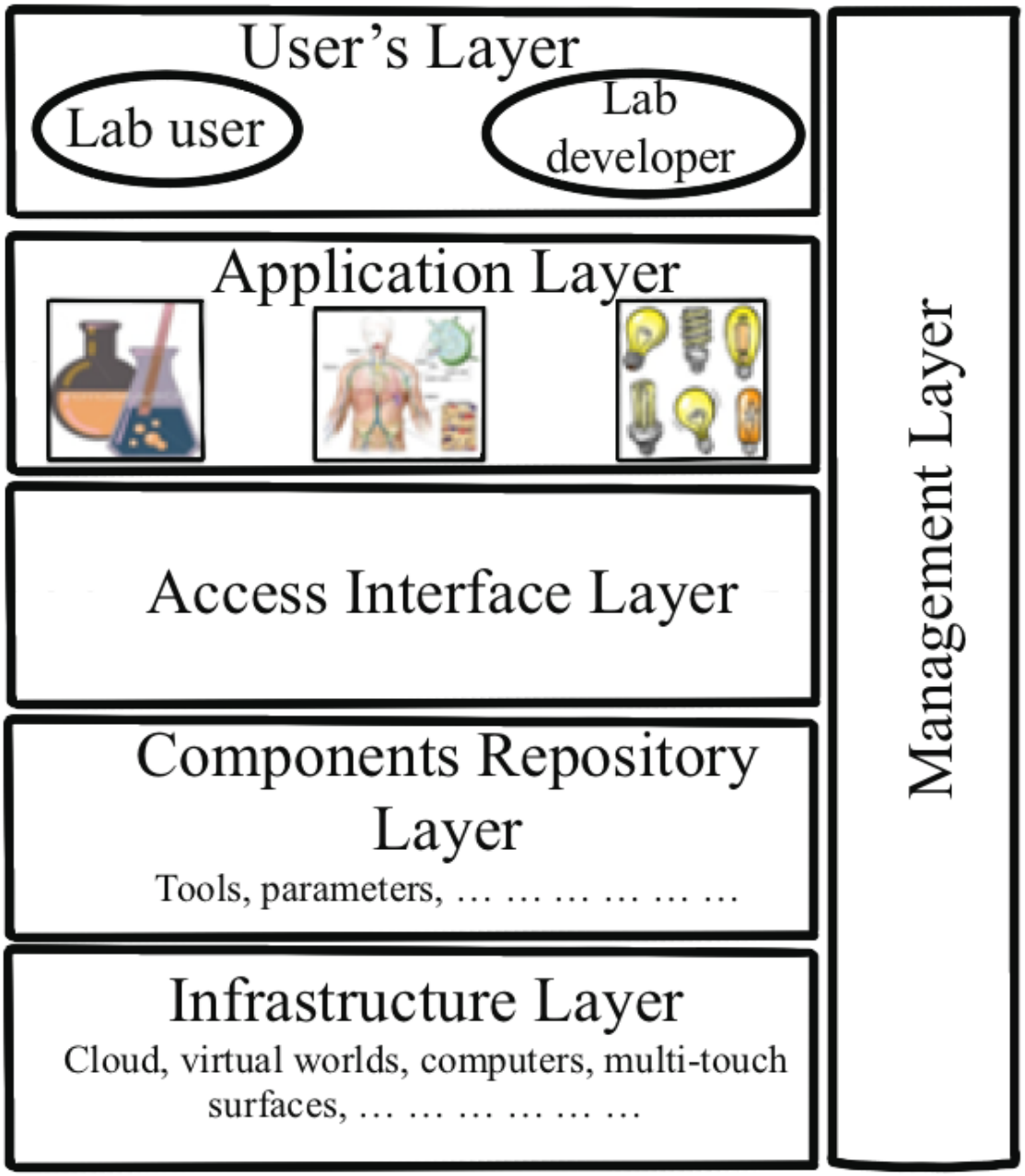


Figure 2-9. Generic Virtual Lab Architecture (Gaber et al., 2013)

Gordillo et al. (2013) provide an understanding of the layout of educational material and discuss the teacher's role. However, the approach, illustrated in Figure 2-10, shows the conceptual layout with limited discussion of gamification elements. Furthermore, the teacher's role follows a scenario-based approach that lacks instructions to replicate the experiment.

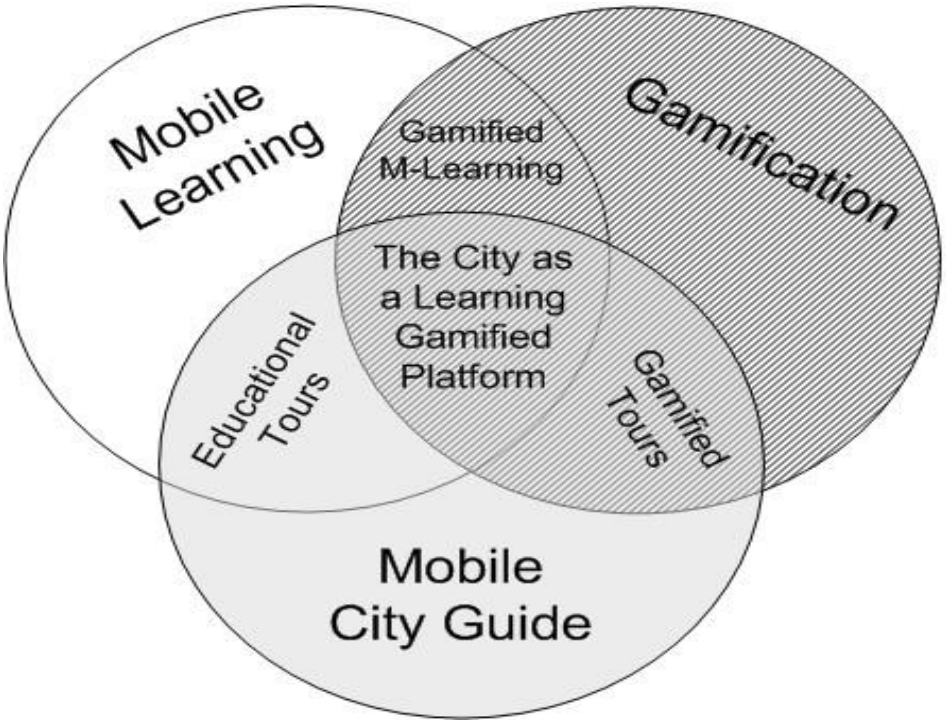


Figure 2-10. Learning Approach (Gordillo et al., 2013)

Additional research (Melero et al., 2013) focuses on the problem-solving technique, integrating teachers' knowledge in puzzle-based game design. This research provides a high level view of the design, as shown in Figure 2-11, and provides more detailed guidance in Figure 2-12.

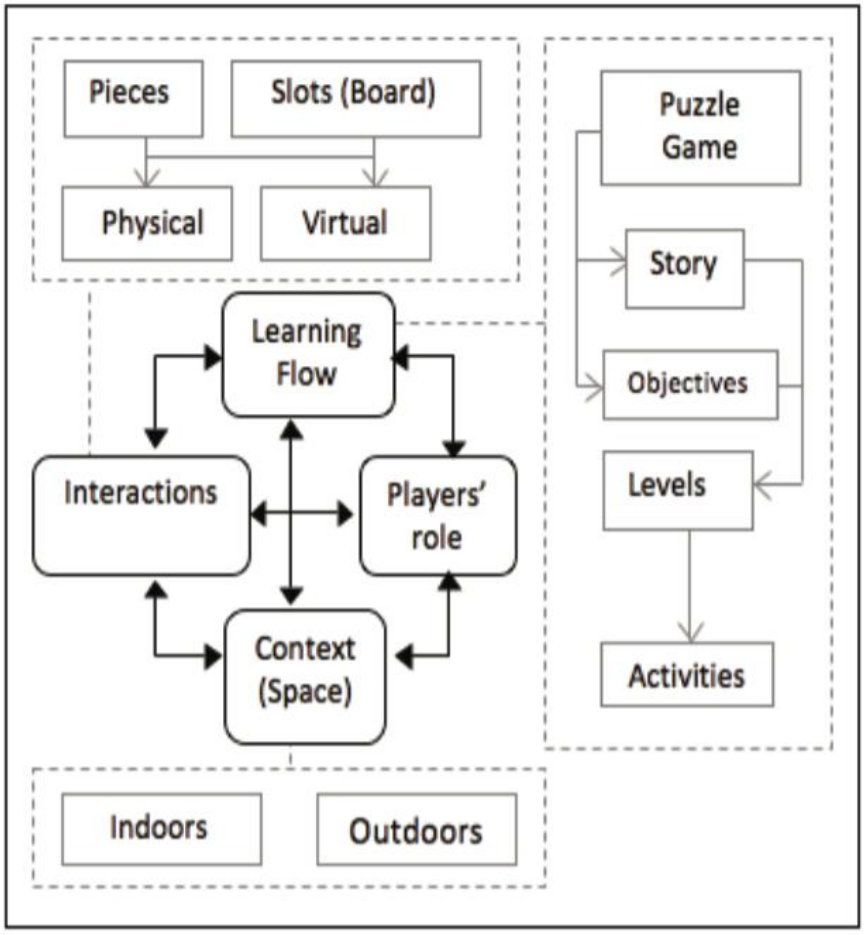


Figure 2-11. The Conceptual Model (Melero et al., 2013)

The design has an introduction stage to explain game elements to the teachers and how the elements can be applied. The next step was for the teachers to fill in the table shown in Figure 2-12. However, the focus was on one type of learning style: problem-solving. Furthermore, the research focuses on teachers' efficiency in understanding the game elements to be used by providing more details and examples, as discussed in Chapter 7 Section 7.5. The aim of this research is to support teachers in learning and applying game elements independently to avoid being overly time-consuming, which teachers pointed out as a disadvantage, as discussed in Chapter 4 Section 4.4.2.

Name of the game		
Game ID		
Feedback	___ points	_____
	___ points	_____
	___ points	_____
	___ points	_____

Level X		
Level ID		_____
Level introduction		_____
Bonus	_____ points	
Feedback	_____ points	_____
	_____ points	_____
	_____ points	_____
	_____ points	_____

Slot X		
Location	_____	
Slot Content	_____	
Hint	Hint Score	
_____	_____ points	
Pieces		
Piece Content	Correct?	Score
_____	Yes/No	_____
Piece Content	Correct?	Score
_____	Yes/No	_____
Piece Content	Correct?	Score
_____	Yes/No	_____

Figure 2-12. Sample of Template Game (Melero et al., 2013)

Simões et al. (2013) provide a high-level view of the framework, illustrated in Figure 2-13, with a description of the design process.

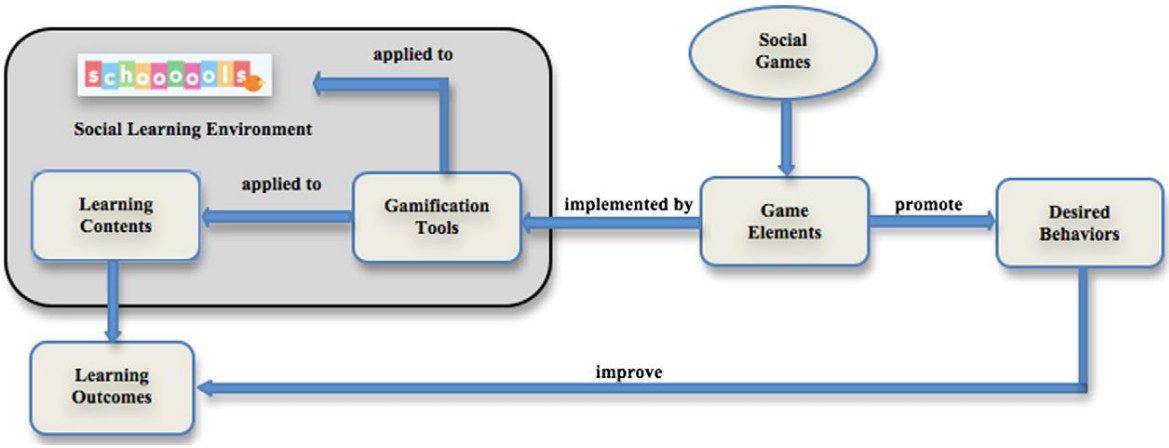


Figure 2-13. Social Gamification Framework (Simões et al., 2013)

On the other hand, the research extends to provide a table of gamification elements suggestions, as illustrated in Table 2-3.

Table 2-3. Game Mechanics Suggestions (Simões et al., 2013)

Game elements	
Game mechanics	Game dynamics
Points	Reward
Levels	Status
Trophies, badges, achievements	Achievement
Virtual goods	Self expression
Leaderboards	Competition
Virtual gifts	Altruism

Browne et al. (2014) outlined a few design steps that followed a learner-centred approach; for example, one of the steps states, 'Immersion: learners need to be immersed and constantly saturated in that which is to be learned'. However, the gamification elements provide an example of three elements implemented in the game.

Another high-level design approach (Dodero et al., 2014) outlined seven requirements for design guidance but did not provide examples to support teachers. For example, one of the requirements states, "*(r7) be innovative, engaging and easy-to-take-up (i.e., not requiring a steep learning curve) for nowadays school teachers, which limits the time required for training them to be part of the co-design team*". Furthermore, it lacks a discussion of gamification elements. Although teachers have been addressed as part of the requirements, the support for them in this research was unclear.

Mystakidis et al. (2014) interviewed teachers to identify the learning objectives of the implemented game beforehand. However, the discussion of gamification elements was limited to storytelling used in the design without further guidance. Another researcher discussed the benefits of designing games to support students in learning (Weitze, 2014, 2015), which includes a high-level framework but is not aimed to support teachers, as illustrated in Figure 2-14.

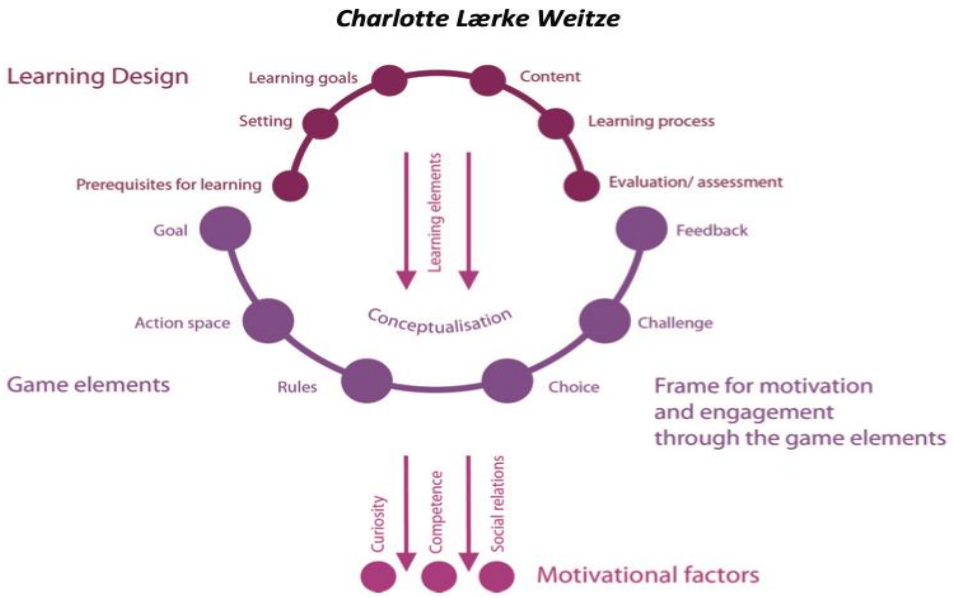


Figure 2-14. The Smiley Model (Weitze, 2014)

Botha and Herselman (2015) consider gamification as an engaging learning method. Their study involved a design to promote teachers' use of technology in a class by a training teacher. They used gamification to train teachers in hopes that it will lead to easier adoption of gamification as a teaching tool. The study results were promising, as the teachers integrated technology into their classes; however, it was not clear whether or not teachers integrated games, in particular. The discussion of applied gamification elements focused on what they should reflect but not how to apply them. For instance, they include 'creation; exploration; discovery; difficulty', but have no guidelines on how to provide the sense of discovery or the sense of exploration.

Lameras and Moumoutzis (2015) provide an overview of the design process from software architects called *GamifyMaths,* shown in Figure 2-15. The gamification design is built using scenarios that lack a structure and do not support decision-making in cases of future implementation. Although this paper emphasises the role of teachers, there was a lack of support for teachers through the proposed design.

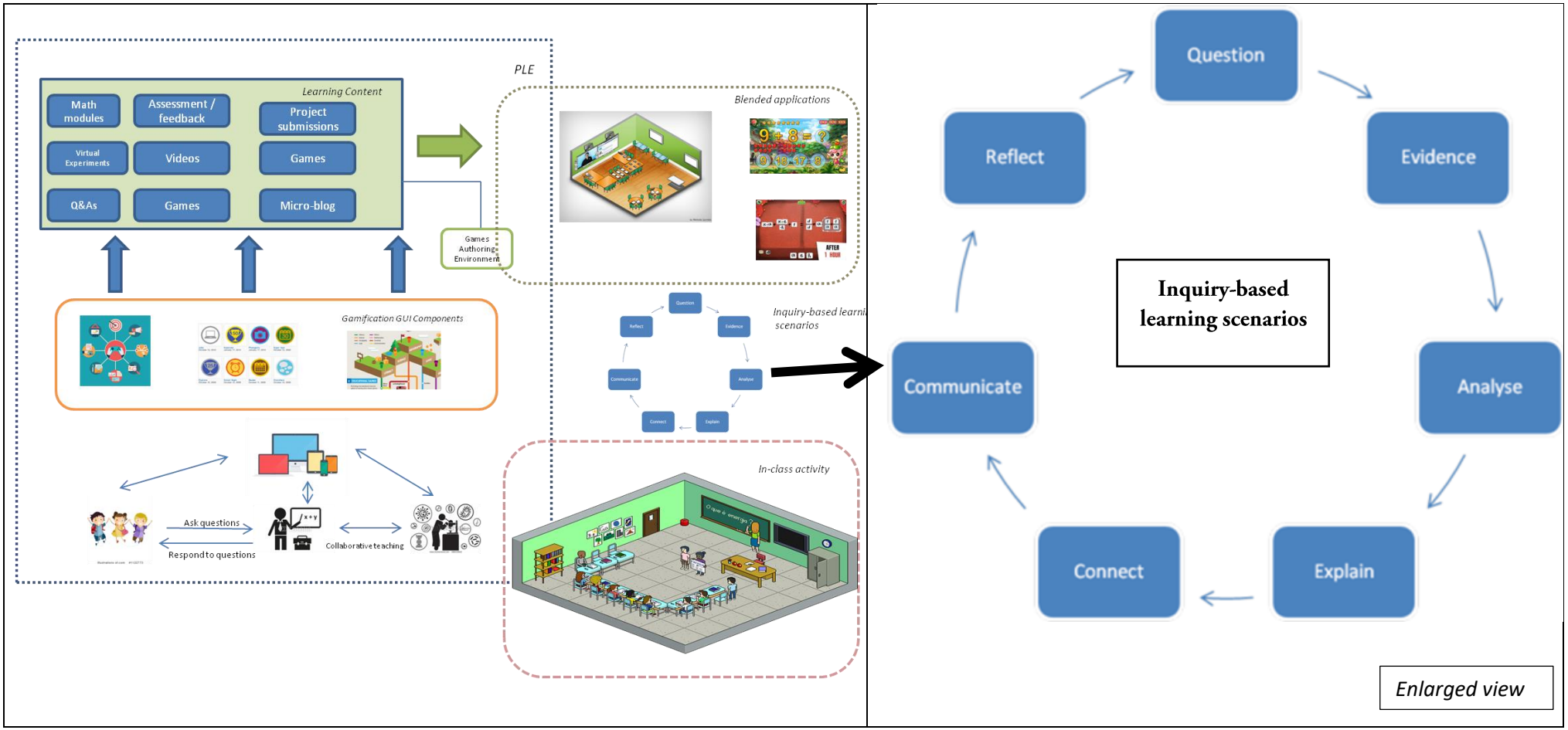


Figure 2-15 The GamifyMaths Framework (Lameras & Moumoutzis, 2015, modified by the Author for Clarity)

Melero et al. (2015) provide an example of teachers' designs, as illustrated in Table 2-4; however, there is no information on the significance of the elements used or examples of other gamification elements to be implemented.

Table 2-4. The Summary of the Teacher Design (Melero et al., 2015)

Design elements	MNAC case
Number levels	3 Levels (one per museum's room)
Number questions	15 Questions
Scores for correct answers	60 Scores more
Scores for incorrect answers	20 Scores less
Number of hints	14 Hints
Scores hints	10 Scores less
Extra bonus	50 Scores more
Hints content	Short text about the context related to the question
Levels information	Short sentence about the museum's room
Feedback messages	Informal

The LEarner-centred GAmified design framework (LEGA) by Baldeón et al. (2016) considered pedagogical aspects, such as Bloom's taxonomy, to build educational content. It identified students' different learning styles, as illustrated in Figure 2-16.

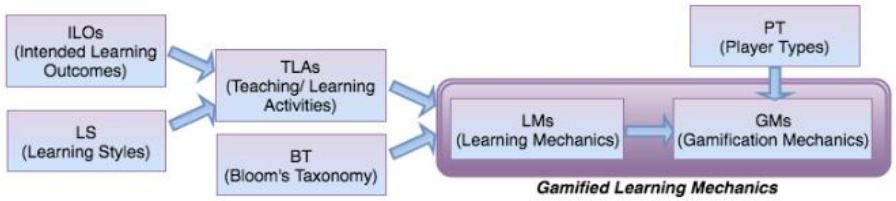


Figure 2-16. The Process of Gamification Mechanics (Baldeón et al., 2016)

In another example, Baldeón et al. (2016) provide tables of suggested game elements related to learner styles (see Figure 2-17). However, the focus of this research is the learner, and the collaboration between game developer and teachers is not discussed.

Teaching/Learning Activities (TLAs)	Learning Mechanics (LMs)	Player Types (PTs)	Gamification Mechanics and Elements (GMs)
- Brainstorming - Group discussion.	BT1-REM: Discover, explore. BT2-UND: Participation, questions and answers. BT3-APP: Action/Task, cooperation, demonstration. BT4-ANA: Analyse, feedback, identify, observation, shadowing. BT5-EVA: Collaboration, hypothesis, incentive, motivation, reflect/discuss. BT6-CRE: Accountability, ownership, planning, responsibility.	All types below	On-boarding/tutorials, signposting, theme, narrative/story, curiosity/mystery box, time pressure, fixed reward schedule.
		SOC	Guilds/teams, social network, social status, social discovery, social pressure.
		FR	Exploration, branching choices, easter eggs, unlockable/rare content, creativity tools, customisation.
		PH	Meaning/purpose, care-taking, access, collect & trade, gifting/sharing, sharing knowledge.
		PLA	Points/experience points (XP), physical rewards/prizes, leaderboards/ladders, badges/achievements, virtual economy, lottery/game of chance.
		DIS	Innovation platform, voting/voice, development tools, anonymity, light touch, anarchy.

Figure 2-17. A Sample of the Tables in Baldeón et al. (2016)

Clarke et al. (2016) provided an overview of the ('SimAULA') design approach, as shown in Figure 2-18. SimAULA is a tool to support teachers in gamifying science content with the focus of inquiry-

based learning. The details used to distinguish learning objectives from the game objectives are not documented. Furthermore, the roles of different stakeholders (i.e. teachers and game designers) in this process are undetermined.

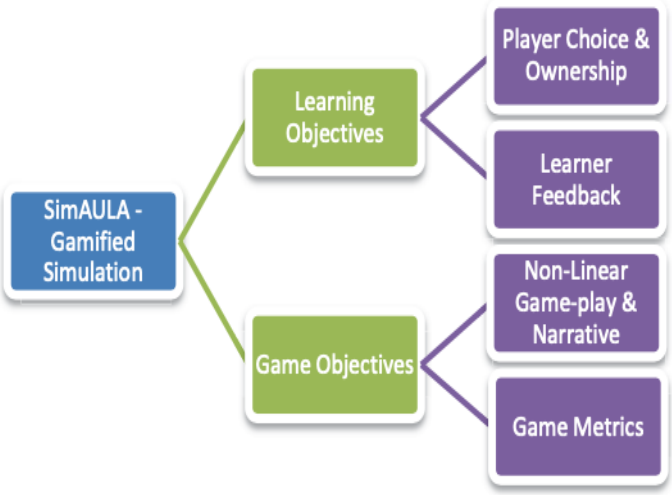


Figure 2-18. The SimAULA Design Approach (Clarke et al., 2016)

Going further, González et al. (2016) conducted an experiment to implement a gamified healthy lifestyle approach into educational activities. The paper presents a detailed description of how the educational activities were transformed into physical activity and introduced a healthy habit. The teachers' and schools' roles as essential elements of behavioural change is acknowledged, and the design method involved teachers on the team. However, there is a lack of guidance on the

gamification elements' applicability and details on the experimental design (e.g. statistical information).

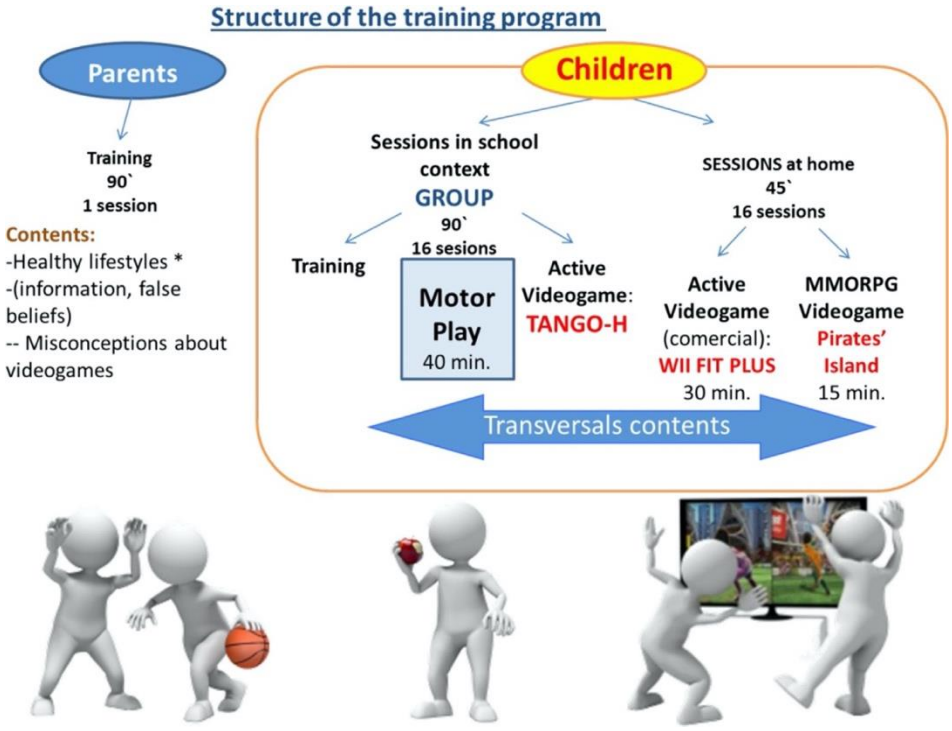


Figure 2-19. Training Session Program (González et al., 2016)

Taking another approach, Kayımbaşıoğlu et al. (2016) followed a database relation outline to present their work, as illustrated in Figure 2-20. In the gamification addition to the design, they followed a scenario-based approach to describe, for instance, 'In this game, at most sixteen different figures (8 pairs) can be placed. The Child needs to couple each figure with the other related figure. The left side of the figures are needed to be dropped on to the related figure, which is placed at the right side of the game, for matching'. The presented text is limited to describing the game events in an expected scenario without signalling the gamification elements and their significance.

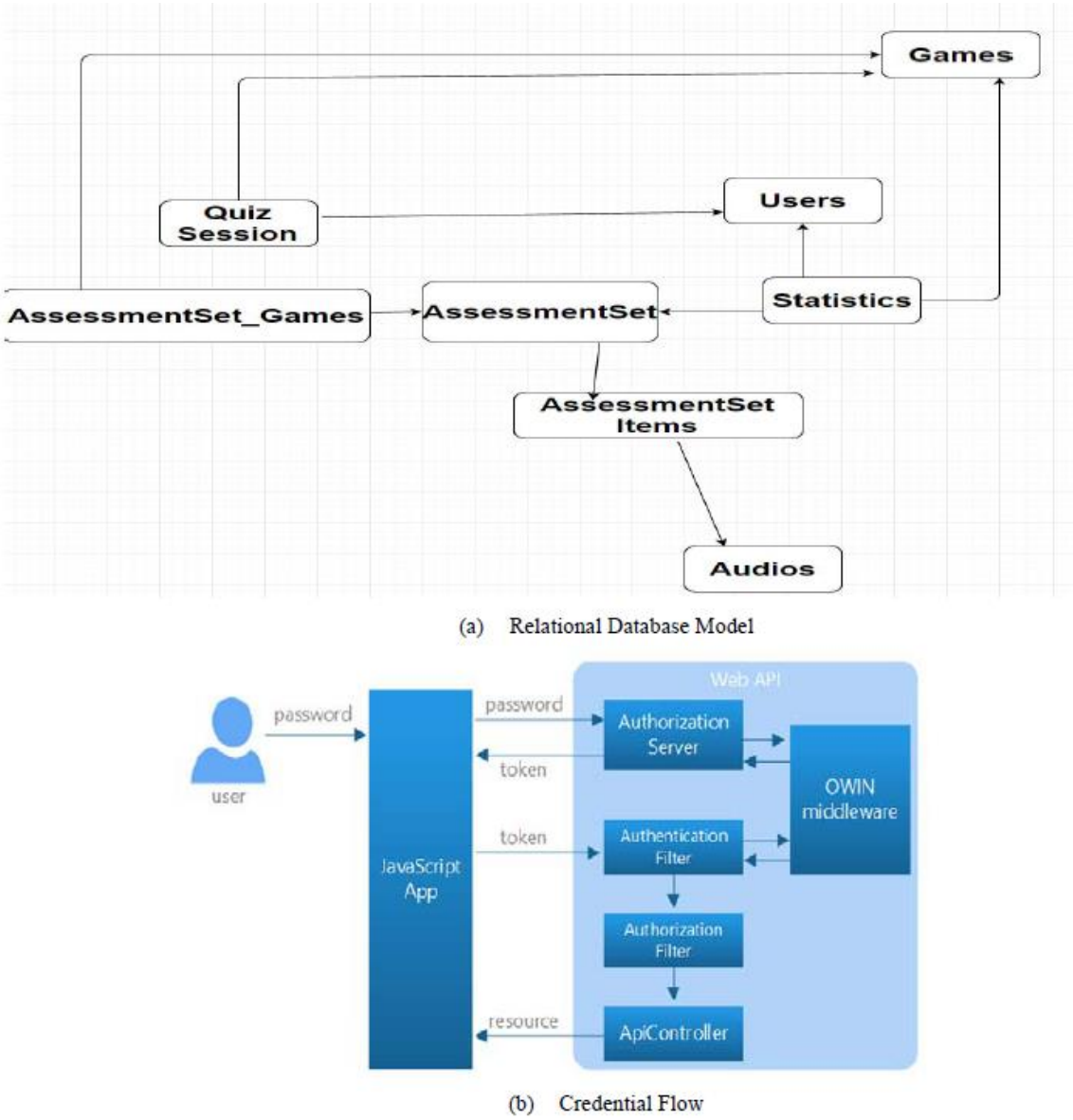


Figure 2-20. A Design System (Kayımbaşıoğlu et al., 2016)

Kermek et al. (2016) focus on implementing rules to support a rewards system through the game. In addition, implemented levels, timing and groups enhance the gamification experience. However, their work provides information on their implementation without emphasising guidelines; likewise, they emphasise the limited support for gamification elements in e-learning platforms

Furthermore, Reng and Schoenau-Fog (2016) provide a model that focuses on comparing different game designs, as illustrated in Figure 2-21. However, there is a lack of description of the design elements.

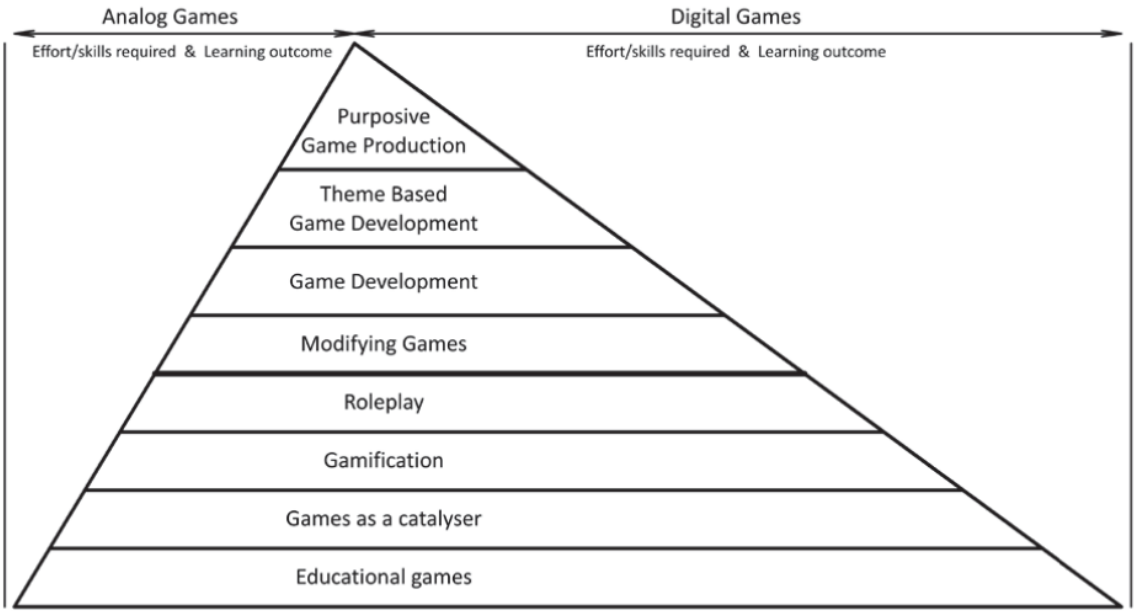


Figure 2-21. The Pyramid of Game Enhanced Learning Model (Reng & Schoenau-Fog, 2016)

Bouzid et al. (2017) used the ADDIE model to build a game considering the pedagogical requirements and motivation; however, gamification mechanics are not applied. Although the value of teachers' input in the design process and the pedagogical consideration is acknowledged, the teachers' role remains undefined.

Landers and Armstrong (2017) used the Technology-Enhanced Training Effectiveness Model, as illustrated in Figure 2-22. The model provides an overview of the design, but the gamification discussion follows a scenario-based approach.

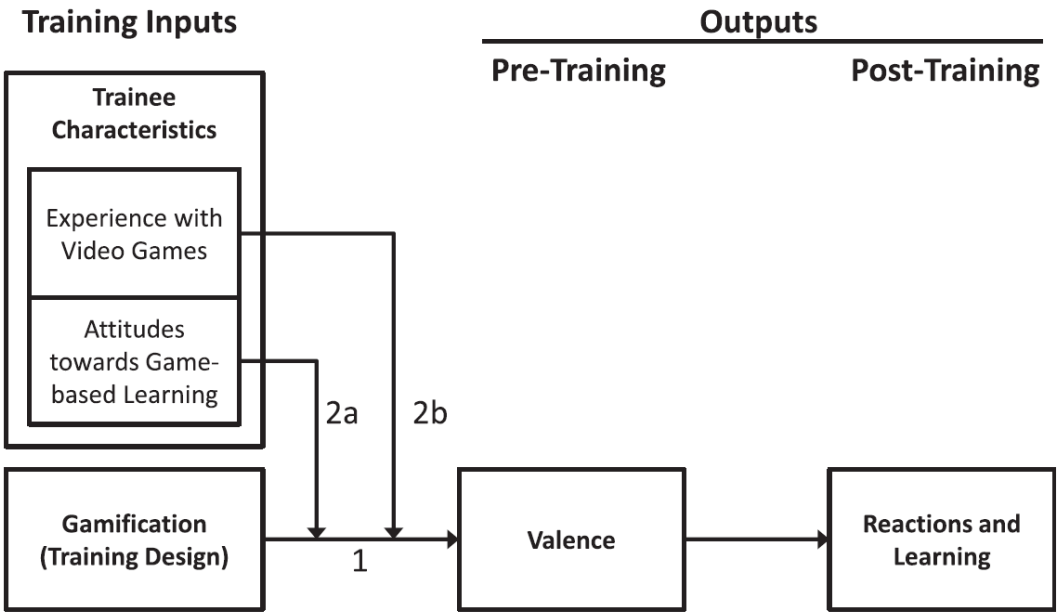


Figure 2-22. Technology-Enhanced Training Effectiveness Model (Landers & Armstrong, 2017)

Özdener (2017) conducted primary research with teachers to set the goals of an e-learning platform and added gamification features for online educational activities. However, there is no discussion of the implementation nor guidance on the chosen gamification elements.

The GAMIFY_SN approach by Toda et al. (2019) was used for instructional design; however, no definition of the terms or differentiations of the terms from regular lesson objectives were provided. The focus was instead on integrating social networks with gamification and validating both. In addition, a discussion of planning was provided. The researchers used a visual representation to document an example of a gamified task, as illustrated in Figure 2-24. However, the visual presentation seems to follow a UML design, which will likely be intimidating or overwhelming for teachers, as the findings in Chapter 5, Section 5.3.3 and 5.5 explain.

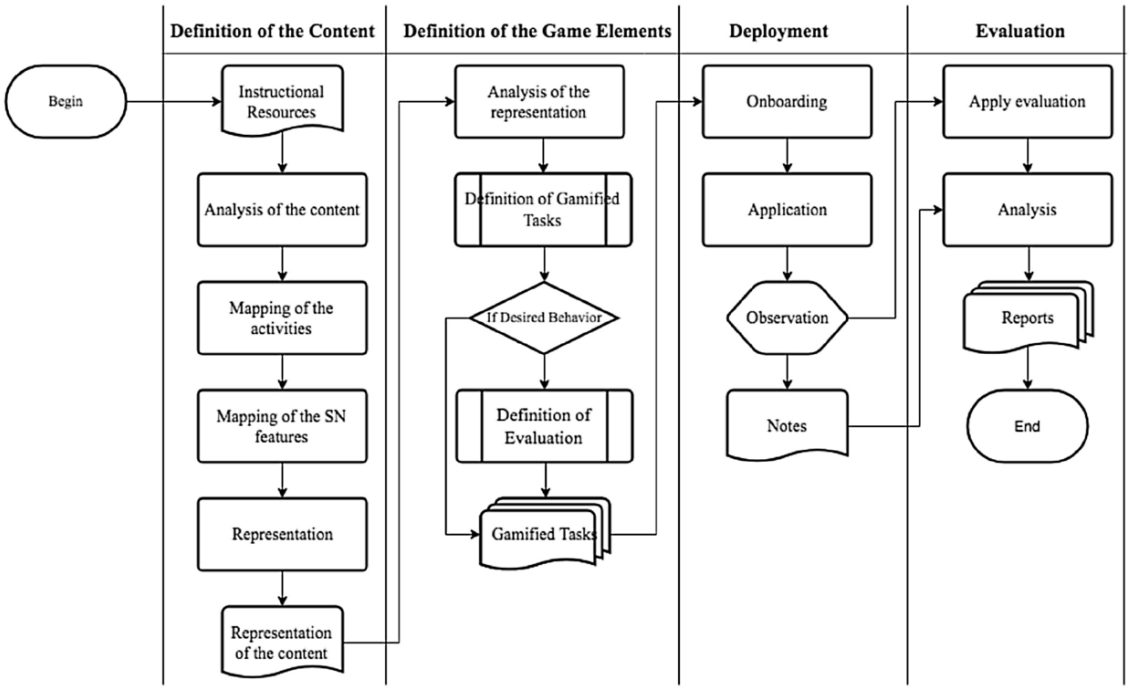


Figure 2-23. GAMIFY-SN (Toda et al., 2019)

Furthermore, Toda et al.'s (2019) outcome is an individual tasks design, whereas this research focuses on the pedagogical design of an overall lesson and includes the learning tasks as goals in the design elements. The gamification sub-elements are part of the Ped-GDD (Game Design Documents) template that represents the whole picture of the design by teachers and game developers, as outlined in Chapter 7, 7.5. The simplicity and intuitiveness of the Ped-GDD was emphasised through interviews with teachers and game developers, as discussed in Chapter 7, Section 7.6. Likewise, Chapter 6 Section 6.3 explains that the game design industry has no specific presentation, and there are few suggestions of GDD that exist on the web. The research gap was identified in Saggah et al. (2018b), and a framework that supports the teachers' synergy and promotes collaboration was also suggested by the authors (Saggah et al., 2018a). Although their research has similarities to the proposed framework in this research, there are important differences.

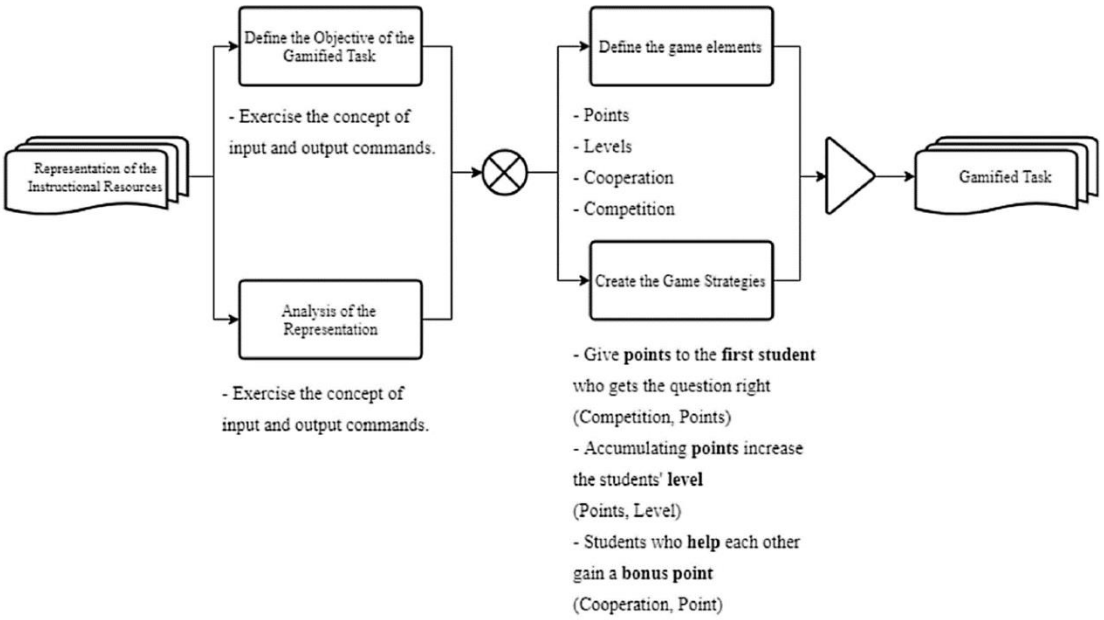


Figure 2-24. A Defined Task (Toda et al., 2019)

Additional research (Malahito & Quimbo, 2020) integrated two design approaches. First, they used the Mechanic-Dynamic-Aesthetics (MDA) framework. Second, they applied the Analysis, Design, Development, Implementation and Evaluation (ADDIE) model, which is a software design model, as illustrated in Figure 2-25. The work does not specify teachers' roles in the design process as explained: 'the mechanics of the e-learning material were conceptualised and aligned with the elements of gamification'. Furthermore, there was no clarity as to who applied either the gaming part or the e-learning material.

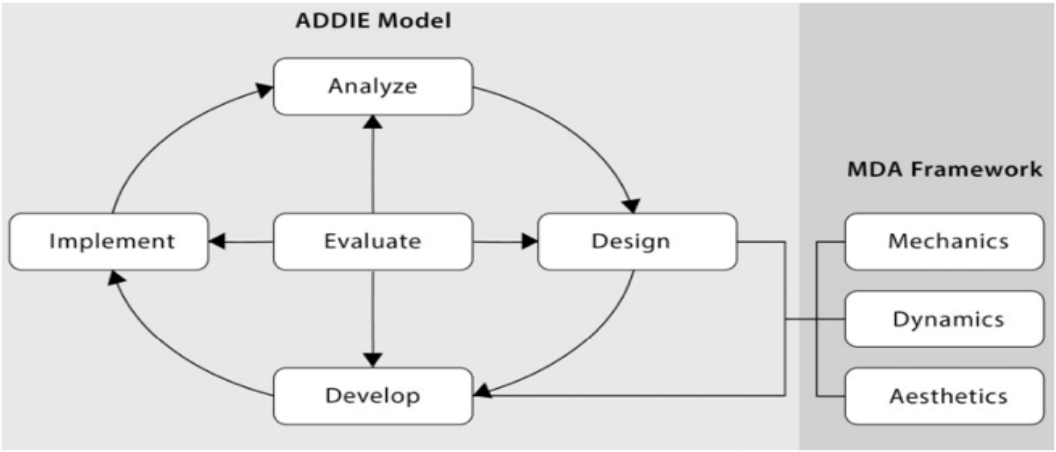


Figure 2-25. Overview of Malahito and Quimbo's (2020) Model

2.8.1 Discussion of the key aspects of the reviewed frameworks

Through the review of the existing gamification design frameworks and approaches, 25 frameworks have been investigated and grouped into four categories, as outlined in Table 2-5. The groups are created around the similarities between the frameworks in relation to the research objectives. The

significance of this step is to identify the gaps and find the common practices in the current literature.

Group 1 relates to the pedagogical context, with limited discussion of gamification. It includes six frameworks that offer a pedagogical context by involving teachers or adding learning theories in gamification design. However, there are no methodological approaches to extract the formal features of the gamification process, which forms a barrier. The six frameworks in this group are represented in a variety of research (Gordillo et al., 2013; Browne et al., 2014; Mystakidis et al., 2014; Botha & Herselman, 2015; González et al., 2016; Özdener, 2017). They acknowledge the value of teachers' input, but the role of the teacher and how their input can be applied in the gamification design process was unclear. It was based on interviews with teachers and did not provide structure nor supporting guidelines.

Group 2 is scenario-based and includes five frameworks that provide a descriptive outline of the design process. The drawback is the need to extract the information, which might be a challenge for some teachers, and therefore, the replicating the design would be difficult — represented in the work of several scholars (Lameras & Moumoutzis, 2015; Kayımbaşıoğlu et al., 2016; Kermek et al., 2016; Bouzid et al., 2017; Landers & Armstrong, 2017), the five frameworks in this group provide descriptive information that presents a challenge to extracting the features of the gamification process or elements.

Group 3 involves a high-level approach and includes seven design frameworks. However, it does not have enough guidance or step-by-step explanation; therefore, the efficiency of these as the design framework to teachers is implausible (Gaber et al., 2013; Dodero et al., 2014; Weitze, 2014, 2015; Clarke et al., 2016; Reng & Schoenau-Fog, 2016; Malahito & Quimbo, 2020). The seven frameworks that present a high-level overview help us to understand the design process. Nonetheless, teachers would require more structured or outlined steps and guidance to support them in the design.

Gamification elements including implementation guidance are featured in Group 4, which is presented in five publications (Simões et al., 2013; Melero et al., 2013; Melero et al., 2015; Baldeón et al., 2016; Toda et al., 2019). However, two of these works were written by the same authors and, therefore, are considered as one approach.

Although some of the frameworks could fit in more than one category, they have been placed in the most representative one.

Table 2-5. Existing Design Framework Categorisation

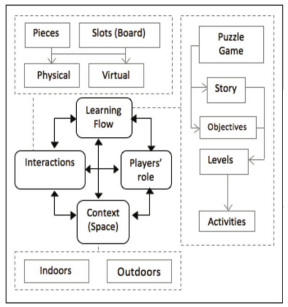
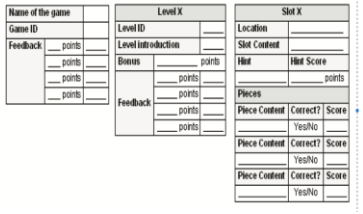
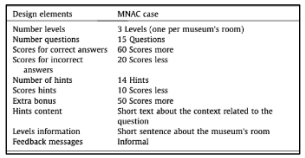
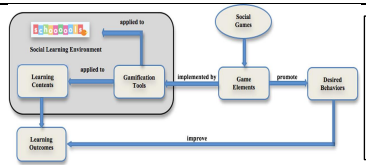
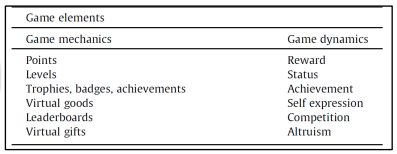
References	Citation No.	Pedagogical context	Scenario-based	High-level approach	Gamification elements implementation guidance
1. (Ibrahim & Jaafar, 2009)					
2. (Ak, 2012)					
3. Gaber et al. (2013)					
4. Gordillo et al. (2013)					
5. Melero et al. (2013)	5				
6. Simões et al. (2013)					
7. Browne et al. (2014)					
8. Dodero et al. (2014)	24				
9. Mystakidis et al. (2014)	4				
10. Weitze (2014)	3				
11. Botha & Herselman (2015)					
12. Lameras & Moumoutzis (2015)					
13. Melero et al. (2015)	30				
14. Weitze (2015)	6				
15. Baldeón et al. (2016)	4				
16. Clarke et al. (2016)					
17. González et al. (2016)					
18. Kayımbaşıoğlu et al. (2016)					
19. Kermek et al. (2016)	3				
20. Reng & Schoenau-Fog (2016)	3				

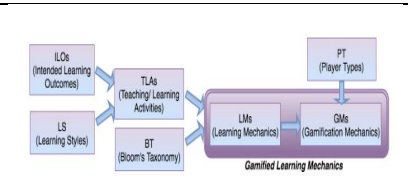
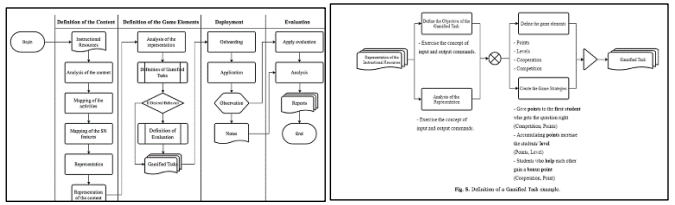
References	Citation No.	Pedagogical context	Scenario-based	High-level approach	Gamification elements implementation guidance
21. Bouzid et al. (2017)					
22. Landers & Armstrong (2017)					
23. Özdener (2017)					
24. Toda et al. (2019)	7				
25. Malahito & Quimbo (2020)					

2.8.2 Discussion and review and reflections of the most related frameworks

This section describes the most related framework that has three features, highlighted in the green boxes in Table 2-5. Foremost, it includes a pedagogical aspect and provides gamification design steps. Second, it has guidance on gamification elements. Last, it provides a high-level overview of the process. The discussion includes five frameworks, as illustrated in Table 2-6. The foregoing discussion in Section 2.8 demonstrated all five frameworks. Table 2-6 provides a comparative review and a miniature depiction of the frameworks.

Table 2-6. Comparison of the Most Relevant Work

	Frameworks	Missing features	Useful design features
1	  (Melero et al., 2013)	• Supports only one game genre, which is puzzle-based. • Focuses on problem-solving. • The high-level view has an overwhelming number of elements and gives no sign of the starting point. • Introduction session, which might not be a feasible option for all teachers.	√ The gamification design uses tables to enable teachers to outline the requirements.
2	 (Melero et al., 2015)	• There is a lack of high-level guidance for teachers through the process. • Lacks information on the significance of the used elements or examples of other gamification elements to be implemented.	√ One of the highly cited articles in the review frameworks that indicates a decent level of usability. √ The approach uses a table as guidance for designing games.
3	  Simões et al. (2013)	• The high-level view is overwhelmingly full of elements with no sign of the starting point. • The table provides game elements without examples to improve the clarity.	√ Uses different presentations on two levels, a high-level diagram and a table for the gamification elements.

	Frameworks	Missing features	Useful design features
4	  (Baldeón et al., 2016)	• The focus of this research is on the learners' style and not the teachers' input. • The collaboration between game developer and teachers is not discussed.	√ Includes learning outcomes as an independent part of the design before applying any gamification elements. √ The gamification elements are presented in tables.
5	 (Toda et al., 2019)	• Focuses on integrating the social network with gamification. • The visual presentation seems to follow a UML design, which will be intimidating or overwhelming for teachers. • The discussion of the approach supports communication between game designers and teachers; however, it is not reflected in the framework outline.	√ Supports communication between game designers and teachers. √ Examples provided for social networks and gamification elements to support the design process.

2.9 Summary of the literature review findings

The complexity of gamification design is acknowledged in Fitz-Walter *et al*. (2017) and Lai *et al*. (2014); therefore, the usability of the framework is highly important. As a result, it is necessary to include a high-level view of the framework to outline the overall design process. In the current frameworks reviewed above, there is a lack of design steps and guidelines to support teachers to overcome technical barriers, such as computer terminology (e.g. UML, access interface layer, game metrics). There is a need to identify both teachers' and game developers' roles to have a coherent design to serve the purpose of improved learning outcomes. This would eliminate the barrier mentioned in Browne *et al*. (2014), as a deprived design will lead gamification to fail its purpose. Therefore, there is a need for a communication platform that includes the two stakeholders—teachers and game developers—in the design process.

The inadequate integration of learning theories might preserve the pedagogical aspect of the design. However, these theories might not be reciprocated by game developers. Conversely, game design terminology could be challenging to some teachers. There is a need to find common ground where both parties can express their design decisions and communicate efficiently. This design gap is also indicated by Toda *et al*. (2019).

Some of the research includes teachers in the design process by interviewing them to identify the game objectives (e.g. Bouzid et al., 2017). Meanwhile, in other research, teachers were required to attend an introductory session (e.g. Melero et al., 2013). Both research attempts are valid; however, they oppose the disadvantage of being time-consuming and not feasible for some teachers. The challenge of time needed to design a game is discussed by Tolentino (2019) describing the gamified course design as 'a demanding task'. Therefore, providing an intuitive framework is the solution offered in this research rather than occupying teachers' schedules with sessions they might not be able to attend, making them less motivated to incorporate gamification in their teaching plan.

The literature indicates that the research area is under-explored in Saudi Arabia, which shows a context gap. The Saudi Arabian 2030 Vision includes the Human Capital Development Program as one of the 13 vision realisation programmes. The development scheme plans to extend education systems for citizens from a young age (Council of Economic and Development Affairs, 2016). As learning becomes an essential part of the Saudi Arabian government plan, there is a need to build a framework based on research to ensure maximising the impact and the affiliate the efforts.

2.10 Conclusion

The previous chapter discussed the research methodology and justified the tools used to conduct this research. This chapter explores the gamification concept and identifies the most common definition as applied to game design elements in a non-game context, as discussed in Section 2.3. The evidence in the literature review supports the positive impact of gamification to promote learning, as discussed in Section 2.4. Teachers' roles are essential to adopt gamification as a teaching and learning tool to harness its benefits, as discussed in Section 2.5.

A literature review carried out to investigate current practices of gamification design, and interestingly, the use of the theoretical underpinnings of the design in the literature was limited, as discussed in Section 2.7.

The review of the existing design frameworks includes 25 publications that were grouped into four categories, as discussed in Section 2.8. The most relevant frameworks that include pedagogical aspects and provide an overview outline and detailed guidance to support teachers in the design process are discussed in Section 2.8.2; some of them do not include what is required to bridge the gulf between the teachers and game developers in the design process, as highlighted in Table 2-6. A summary of the barriers and challenges that hinder teachers' integration into the design process is outlined in Section2.9.

There is a need for a communication platform that includes the two stakeholders—teachers and game developers—in the design process. This would keep each of them focused on their area of expertise and avoid the disadvantage of taking up too much of their time (i.e. the teachers will not dive into programming or game design technicalities). Also, game developers do not need to have a solid background in learning theories. Each stakeholder will provide their knowledge in a collaborative platform. Consequently, this research will look into designing a holistic framework to overcome the barriers outlined in the existing framework, such as inadequate representation of teachers' input, limited discussion of applied gamification elements, lack of steps and guidance to support teachers.

Chapter 3. Developing an Agile Holistic Gamified Pedagogical Design (AH-GPD) Framework

3.1 Introduction

The previous chapter concluded that the majority of current research on gamification design is centred on practical steps, such as interface and coding, rather than theoretical concepts. This chapter discusses the process of developing a framework that provides both a high-level view and the steps to support teachers in developing games with the intention of designing an Agile Holistic Gamified Pedagogical Design (AH-GPD) framework. The development of this high-level framework is based on two software design models: Analysis, Design, Development, Implementation, and Evaluation (ADDIE) and Usability-Software Development Life Cycle (U-SDLC). This chapter analyses the features adapted from the two software models to support the synergy between teachers and game developers in the design process. Additionally, this chapter discusses and identifies gamification elements in relation to learning from the literature.

3.2 Context

The previous chapter explains the gamification design practices followed in the literature review, found in Chapter 2 Section 2.8.2. The custom and practice in existing frameworks have two things in common. Firstly, they share a framework that provides a high-level overview of the process. Secondly, providing examples of gamification elements in the form of tables (Melero et al., 2015; Simões et al., 2013; Baldeón et al., 2016) or a list (Toda et al., 2019). Moreover, they possess the need for teacher-game developer collaboration, as this joint expertise would deliver an adequate learning experience (Kayımbaşıoğlu et al., 2016; Toda et al., 2019). An in-depth discussion of teachers' contribution can be found in Chapter 2 Section 2.5. Taking this into consideration, it is important to have a communication platform between the teachers and game developers as stakeholders. This chapter discusses the development and design of AH-GPD framework, as illustrated in Figure 3-1.

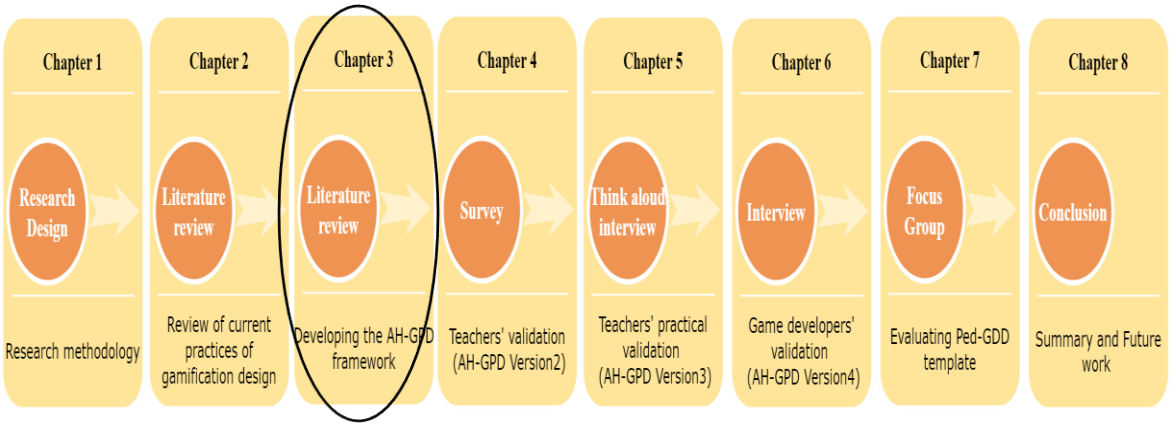


Figure 3-1. Chapter 3 in Thesis Layout

This chapter is composed of three sections, which are outlined in Figure 3-2. The first of these sections focuses on developing the high-level framework by combing ADDIE and U-SDLC models into a gamification design. The second section analyses the framework stages and provides definition. Last section discusses the process of identifying the gamification elements from the literature review and the HCI elements to be incorporated into the framework. According to Deterding et al. (2011), HCI designing principles are used to create an enjoyable interface and are precursors to gamification.

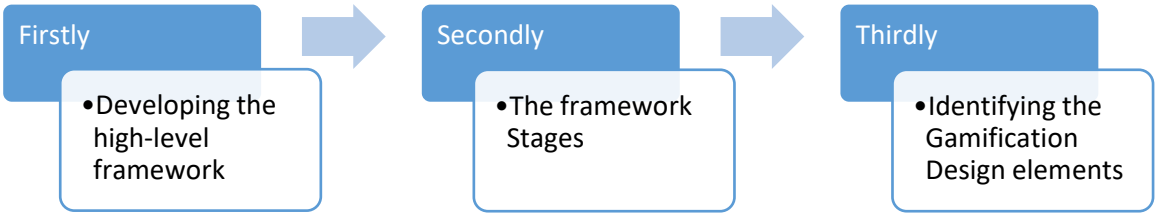


Figure 3-2. Chapter 3 Outline

3.3 Developing the high-level framework

This research adopts Jabareen's (2009) view of a framework, which describes "a network or a plane of interlinked concepts that together provide a comprehensive understanding of a phenomenon or phenomena" (Jabareen, 2009: 51). Thus, the framework in this research is used as an anchor point for the gamified pedagogy designing process, providing an agile holistic structure that illustrates the synergy between teachers and game developers.

According to Cooper and Scacchi (2015), computer game design is a software engineering practice. Therefore, the search for a software design model that supports learning and training has resulted in Analysis, Design, Development, Implementation, and Evaluation (ADDIE). According to Kapp (2012), ADDIE is a model that follows a waterfall software approach, as demonstrated in Figure 3-3. According to Malahito and Quimbo (2020), ADDIE is a project management tool that relates to multimedia instructional design. ADDIE is an instructional design model developed by the US army

in 1978 (Kurt, 2018; Hughes, 2019) for instructional design and was used for all US Armed Forces (Kurt, 2018). The ADDIE model has been used in gamification design in an educational context (Bouzid et al., 2017; Malahito & Quimbo, 2020), as discussed in Chapter 2 Section 2.8. ADDIE is an instructional design model that has recently become popular in a learning context (Huang et al., 2005; Mayfield, 2013; Nadiyah & Faaizah, 2015; Budoya et al., 2019). Mayfield (2013) discussed the advantages of using ADDIE in the business industry for employee training purposes, emphasising that the model provides collaborative structure. In addition, Mayfield's (2013) study produced an extensive evaluation of the ADDIE model, concluding that it has helped refine the learning goals.

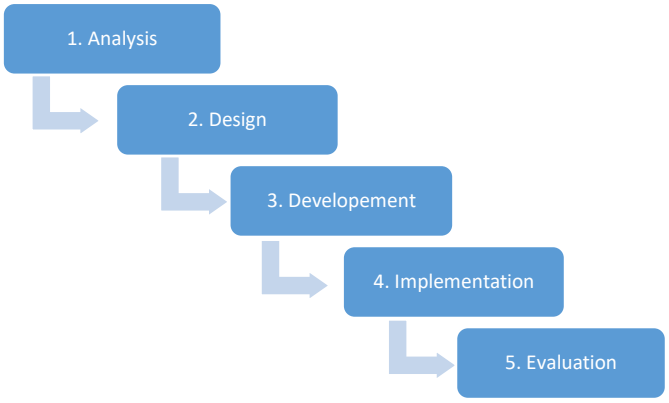


Figure 3-3. The ADDIE Model

ADDIE is one of the most recognised models in game-based learning (Kapp, 2012; Widyastuti & Susiana, 2019). The ADDIE model has been used in two frameworks reviewed in the related literature review (Bouzid et al., 2017; Malahito & Quimbo, 2020), which are discussed in Chapter 2 Section 2.8. Therefore, adapting the ADDIE model will support this research in overcoming the barrier of establishing a communication platform that supports both game developers and teachers. This is identified as one of the barriers in current design frameworks, as discussed in Chapter 2 Section 2.9. According to Kapp (2012), effective game design can be achieved by mixing ADDIE, which is a waterfall approach, with a scrum approach that provides an agile and iterative design. The idea of mixing more than one approach or model is presented in (Malahito & Quimbo, 2020) integrating the ADDIE model with the Mechanic-Dynamic-Aesthetic (MDA) gamification design approach, as presented in Figure 2-23. Noticeably, the ADDIE model changes from a linear waterfall into a cycle. In research conducted by Bouzid *et al*. (2017), the design stage consisted of three levels: the content, the look and feel, and the game-play. The practice of breaking down the design stage is to first identify the educational goals, then the interface sketch, and finally the gamification coding process. It is clear that the ADDIE model has been adopted and is considered a commonly used design approach in a learning context. Given this, ADDIE is an important part of developing the framework in this research. Nonetheless, Deterding *et al.* (2011) put the gamification design as an extension to HCI designing principles. Velmourougan *et al*. (2014) conducted an extensive comparative review of software design and proposed the Usability-

Software Development Life Cycle model (U-SDLC), which is shown in Figure 3-4. It is necessary to consider the U-SDLC design cycle in order to apply agility to the proposed framework. This aligns with Hughes (2019) suggestion of combing ADDIE with agile approaches would improve content development for learning and training purposes.

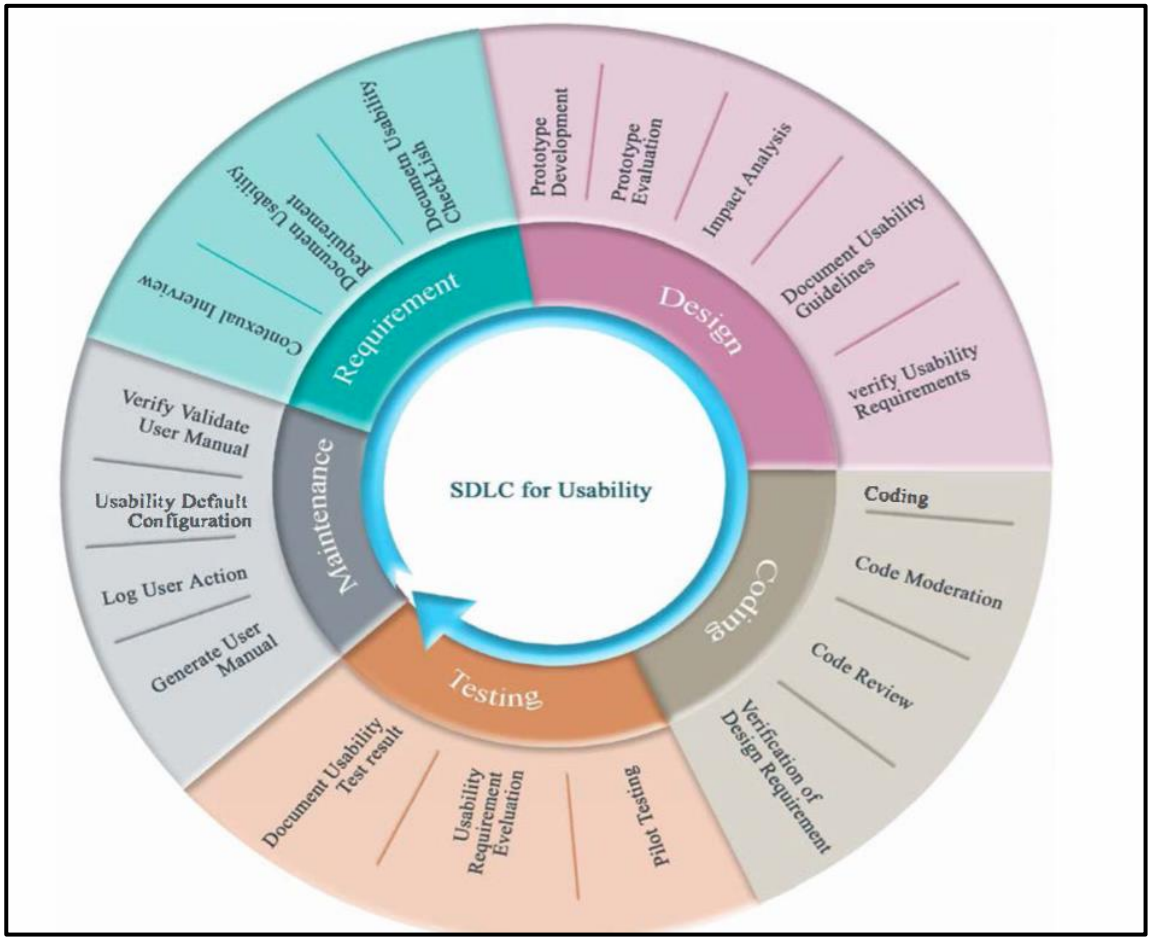


Figure 3-4. U-SDLC Model (Velmourougan et al., 2014)

3.3.1 The adapted features from the two software design models

This section summarises the features adapted from both ADDIE and U-SDLC to develop the proposed framework, as outlined in Table 3-1.

Table 3-1. Abstracting the High-level Framework

<table>
<tr><th colspan="2">The proposed framework</th><th>ADDIE model</th><th>U-SDLC model</th></tr>
<tr><td colspan="2">1. Requirement</td><td>Analysis stage identifies system requirements
Starting point of the process</td><td>Requirement is the name of the stage</td></tr>
<tr><td colspan="2">2. Gamification Design</td><td rowspan="3">Merges Design and Development into one stage. The integration of both teachers and game developers provides the outcome ready for the two stages.
Parallel steps of the Design stage are adopted from Bouzid et al. (2017) application of ADDIE</td><td rowspan="3">The iteration to check the usability of the software is provided in a two-way arrow between the teachers and game developers as the stakeholders of the gamification design process.
The Human-Computer Interaction portion of the design is adopted from the usability design.
The outcome will have an interface sketch, as the cycle indicates a prototype diagram.</td></tr>
<tr><td rowspan="2">Game Aspects</td><td>Educational content/ curriculum</td></tr>
<tr><td>Human-Computer Interaction</td></tr>
<tr><td colspan="2">3. Implementation</td><td>Designing the end product and implementing it in the environment using a game engine etc.</td><td>Replace the Coding stage</td></tr>
<tr><td colspan="2">4. Testing & Evaluation</td><td>Adapt the evaluation stage as part of the framework</td><td>Adapt the testing stage as part of the framework
The iteration of the cycle is replicated in the last portion with an arrow to indicate the agile approach.</td></tr>
</table>

The identified elements in the proposed framework have adapted several elements for the U-SDLC model. These are illustrated in green in Figure 3-5.

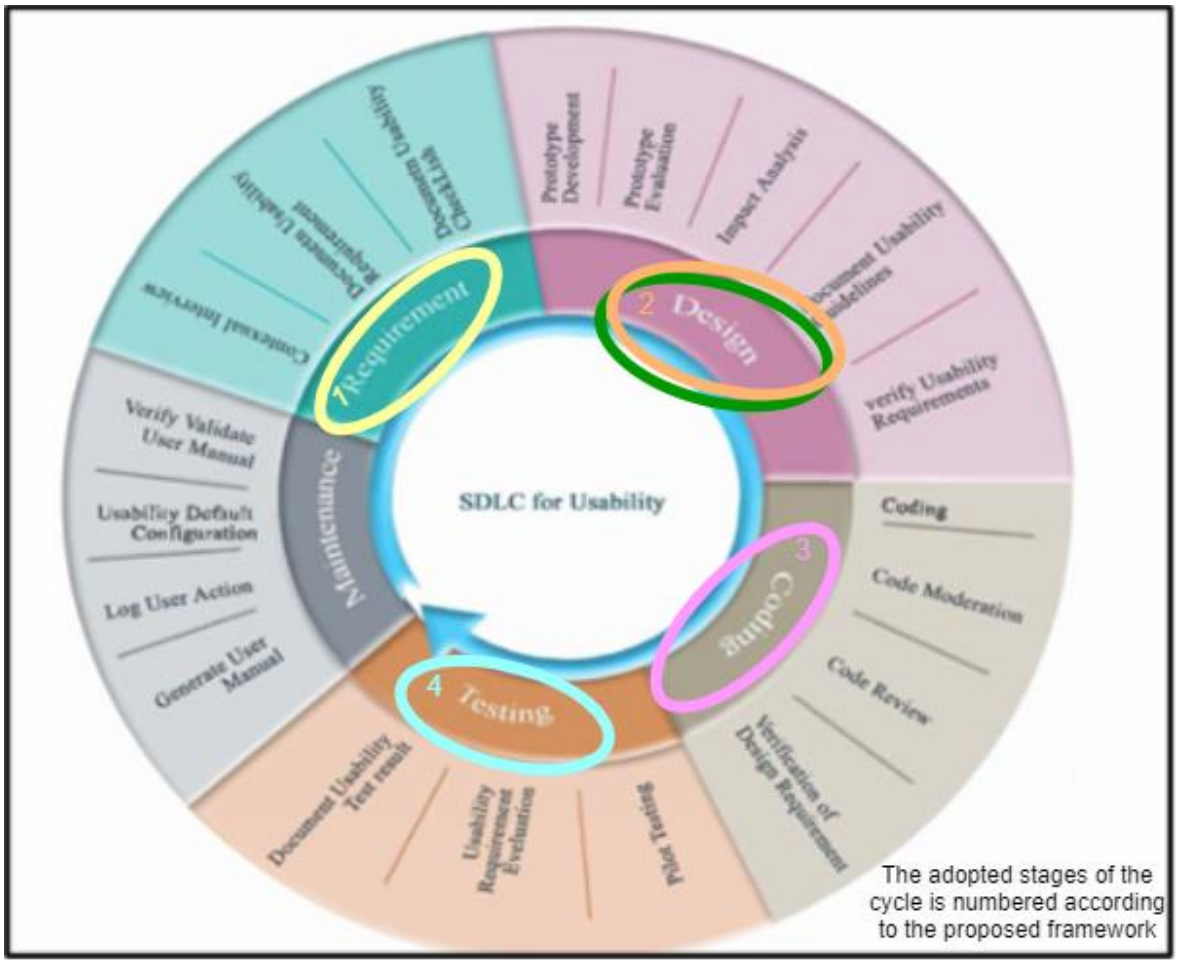


Figure 3-5. The Adopted Features from U-SDLC Model Modified by Author

The outcome is an extended version of the ADDIE model that adopts the agility of the U-SDLC model to create the proposed framework. The extension applies specifically to the Stage 2 Gamification Design that supports the interaction and synergy between teachers and game developers in task design.

3.4 The proposed AH-GPD framework

The proposed Agile Holistic Gamified Pedagogical Design (AH-GPD) framework has four stages: Requirements, Gamification Design, Implementation and Testing and Evaluation, all of which are illustrated in Figure 3-6. The four stages provide a high-level view of the framework and adapt the ADDIE model. The agility of the framework in adapting the U-SDLC model adds elements to the Gamification Design stage, as discussed in Section 3.5 .

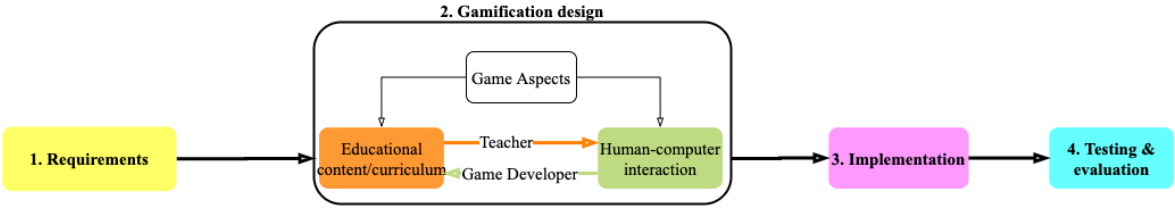


Figure 3-6. The Proposed AH-GPD High-level Overview

3.4.1 Stage 1: Requirements

An initial designing stage necessitates empirical studies in order to establish system requirements. In this phase, the focus is on three factors. Firstly, the age of the students. Secondly, the aim of the game: extra practice, rewards mechanism, main delivery, and homework. Thirdly, the preferred platform: computers, iPads, and interactive whiteboards based on school infrastructure.

3.4.2 Stage 2: Gamification Design

Accomplishing the game design process requires a collaborative team. Kapp (2012) considered the 'subject expert' as an asset to the design process for any training or learning game—referring to the person providing the educational content of the game. In a pedagogical gamification context, teacher input is required. Therefore, the teachers are part of this stage. A game designing team could be as big or small as the project and the scale of the game require. Terms such as game developer, designer, interface designer may be used interchangeably; for consistency purposes, the term 'game developer' in this research refers to the interface and technical-related matter of the game design.

A. Game aspects

This section discusses the current ways of representing the gamification elements. Stott and Neustaedter (2013) outlined the game design dynamics in four elements: Freedom to Fail, Rapid Feedback, Progression, and Storytelling. The four elements were applied in Botha *et al.* (2014) and Senderek *et al*. (2015). In another gamification paper, the elements referred to as concepts introduced by Noran and Ovidiu (2016), as shown in Figure 3-7.

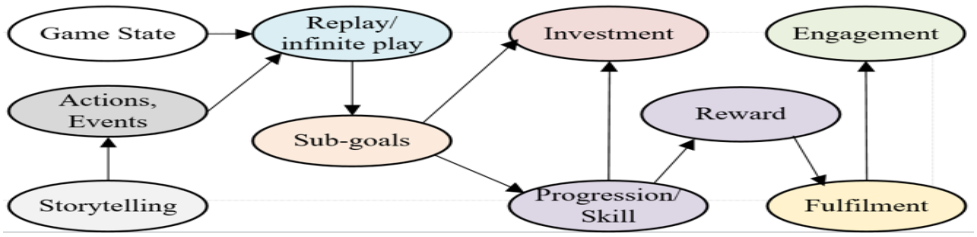


Figure 3-7. Relation between Gaming Concepts (Noran & Ovidiu, 2016)

A more detailed example of large-scale design is presented in Chou (2016), which introduced the Octalysis framework, a gamification design framework for everyone, which is illustrated in Figure 3-8. The framework consists of eight core drivers: Epic Meaning and Calling; Development and Accomplishment; Empowerment of Creativity and Feedback; Ownership and Possession; Social Influence and Relatedness; Scarcity and Impatience; Unpredictability and Curiosity, and Loss and Avoidance.

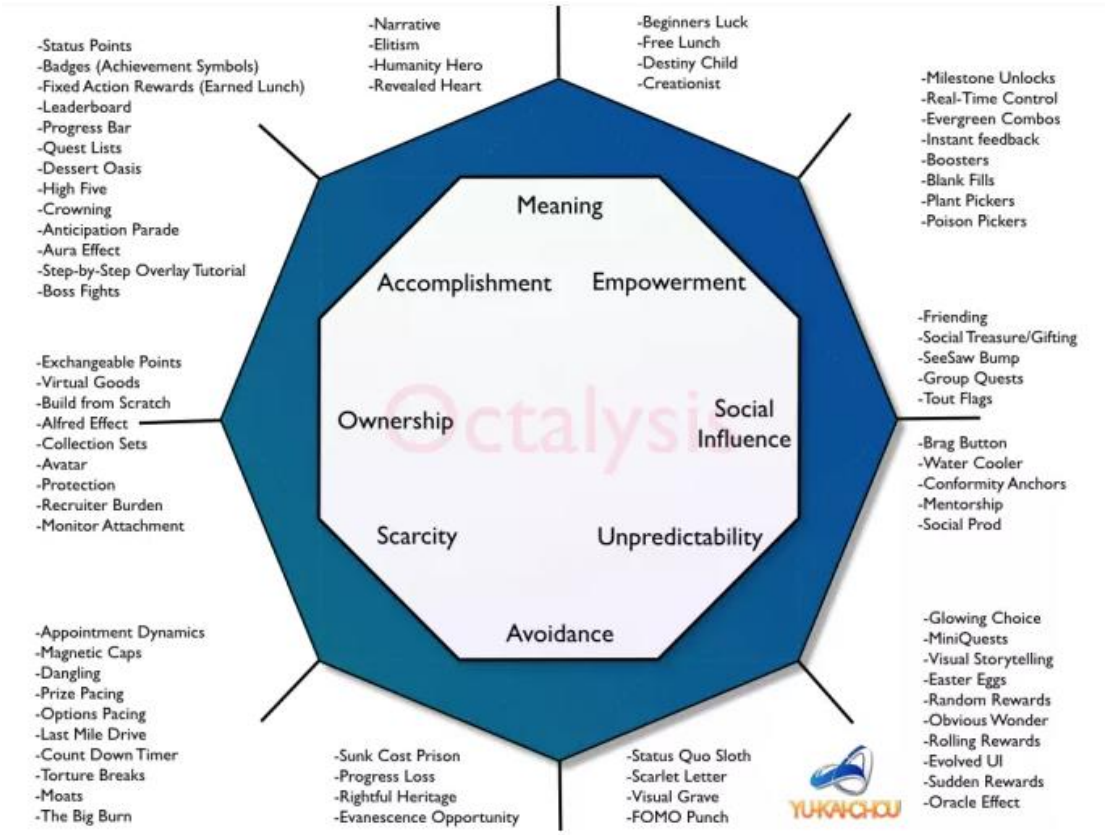


Figure 3-8. Octalysis Framework (Chou, 2016)

The existing literature demonstrates a lack of consistency by using terms such as 'mechanics', 'dynamics', and 'elements'. For example, Simões *et al.* (2013) explained 'dynamics' as elements to enhance players' determination towards the game, while the term relates to enhancing players' motivation. Goshevski *et al*. (2017) agreed with Simões et al. (2013) in the Dynamics concept and

explained that they are the players' motivation to accomplish tasks. The different view is in a Mechanics concept which Goshevski et al. (2017) explained as the part of the game that influences players' behaviour. Another attempt to identify the terms by Ašeriškis and Damaševičius (2014) distinguished the terms 'Mechanics' and 'Dynamics', as 'Mechanics' relates to the data representation and algorithm while 'Dynamics' represents the run-time of the game. Interestingly, there are references that do not recognise the difference, such as Toda *et al*. (2015) and, Kusuma *et al*. (2018). For instance, Kusuma et al. (2018) referred to rewards in the same article as 'dynamic' and sometimes 'mechanic'.

The aforementioned discussion demonstrates that the current literature lacks a consensus on the definition of gamification elements. In this research, gamification elements terms will be used to refer to dynamics, mechanics, and concepts, adopting Kapp (2012): "Game elements work individually and collectively to create the game-paying experience" (Kapp, 2012, p. 50).

B. Educational content/transforming curriculum

The start of the Gamification Design stage is building an educational content/curriculum by teachers, demonstrated in orange in Figure 3-6. The rationale of placing teachers' design decision first is to reflect the importance current researchers place on the pedagogical input. For instance, Mystakidis *et al*. (2014) designed a gamified e-learning environment in which an interview with teachers was the initial step of the design to identify the learning objectives. Botha and Herselman (2015) described the teacher as "content and context expert" in the process of designing a gamification course that supports their professional development. Schulz *et al*. (2015) investigated teachers' motivation toward an e-learning design, and the research suggested that teachers should be more involved in the design process. The teachers' role will be validated in Chapters 4 and 5.

C. Human-computer interaction (HCI)

The significance of adding HCI elements to the framework, as explained by Fitz-Walter et al. (2017), lies in the fact that applying gamification elements requires integrating usability principles. Along similar lines, Deterding *et al.* (2011) discussed that HCI designing principles creating an enjoyable interface is a gamification precursor. Dix *et al.* (2004) stated that the interface must be built incorporating three aspects: Learnability, Flexibility, and Usability. According to Kapp (2012), HCI elements are the responsibility of game developers, as shown in Figure 3-9. Therefore, the elements are categorised accordingly in green boxes. The HCI elements are validated in Chapter 6.

3.4.3 Stage 3: Implementation

The outcome of Stage 2: Gamification Design is a document to be used in the implementation stage. The platform choice for the game execution should be made in the first stage (Requirements) and checked for compatibility in this stage before choosing the game engine. Based on the team game

development experience and programming preferences, the decision will be made for the game engine. Examples of this include Construct, Yo-Yo games, and Unity. In addition, Malahito and Quimbo (2020) describes the process of implementation as presenting the game in its context, which is a prototype that functions in the intended platform.

3.4.4 Stage 4: Testing and evaluation

This stage of AH-GPD framework tests the prototype, evaluates the interface with teachers and students, and updates the game design accordingly. According to Nadiyah and Faaizah (2015), "Evaluation based on user acceptance will determine the successfulness of the prototype with a proper learning outcome. This feedback is greatly important to ensure the prototype functionality and readiness for real study" (Nadiyah & Faaizah 2015, p.1806). This is in accordance with a study by Bouzid et al. (2017), which conducted an evaluation of the game using a small group from the target audience and examined the results. This step is beneficial for applying necessary changes.

Lazar *et al*. (2010) explained various interface testing techniques, including automated data collection methods and measuring the human response. Automated data collection could be done through weblog and active screen time. Another technique is measuring human response that requires high-level technical equipment to monitor players' attention throughout the game. Evaluating the design product may use the HCI elements, which appear in Stage 2 and are the subject of in-depth discussion in Chapter 6. These HCI elements can also be found in the final version of the framework.

3.5 Identifying gamification elements

As part of the process of identifying the gamification elements, a comprehensive literature review comprised of over 50 articles and books was constructed. A thorough list of the gamification elements references can be found in Appendix C. This section discusses the 14 identified elements, which are illustrated in Figure 3-9. These do not follow a hierarchical order and are described as follows:

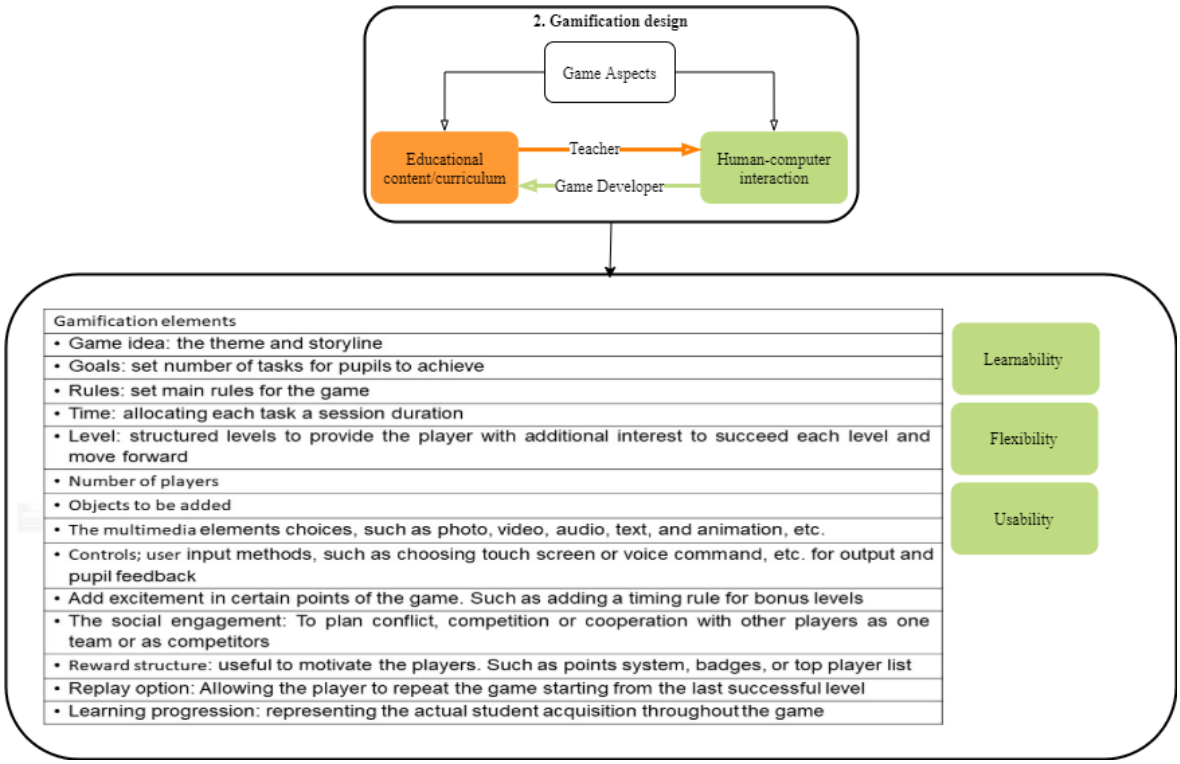


Figure 3-9. Stage 2 of the AH-GPD

Element 1. Game idea: the theme and storyline

The literature shows a consensus on the positive impact of the game idea on the coherence of the design. Villagrasa and Duran (2013) discussed that having a story composed of the learning tasks will positively influence the student experience and provide the game with context. According to Mystakidis *et al*. (2014), a storyline is a beneficial way to increase students' retention, and applying this game mechanic, referred to as 'digital storytelling', provides a rich learning experience for students, in this case study, a history class. A story could add meaningful experience to the players (Chou, 2016; Sailer et al., 2017).

Kapp (2012) suggested that a game idea could be achieved through characters, plot, tension, and resolution. The current gamification design practices refer to the game idea using different terms (e.g., narrative, storyline, digital storytelling, and visual representation of the learning path), which is reflected in the following discussion. Senderek *et al*. (2015) explained that a game idea could be represented through; storyline, theme. Botha *et al*. (2014) acknowledged the importance of providing a narrative for the learning journey and represented each objective with a badge. A practical approach is presented in the work of Botha and Herselman (2015), which considered the story as an interactive image illustrating the learning goals on a pathway from the start to the final goal. Every achievement is reflected in the image as a highlighted badge. However, this seems to represent the game's progression rather than its narrative content. Both aspects of the research considered a visual representation with badges as a representation of the game idea. The badges in this research considered a reward element, which is discussed independently in Element 12.

Similarly, González *et al.* (2016) used a narration of a created Pirate Island story and the theme and continued to use badges reflecting the same pirate theme. Badges are discussed as part of Rewards in Element 12.

Some of the research in the literature have used the concept with little or no discussion of how it was applied or what its significance is (Melero et al., 2013; Lameras & Moumoutzis, 2015; Goshevski et al., 2017). Goshevski *et al*. (2017) highlighted the elements included in each platform and referred to connecting the games through a cohesive context as narrative. However, in this research, the element is referred to as a storyline.

Element 2. Goals: set a number of tasks for pupils to achieve

Sweetser and Wyeth (2005) mentioned clear goals as part of GameFlow design and interestingly suggested introducing the primary goals earlier on the game. However, this research provides the elements without ranking them in order to avoid influencing the participants in the next data collection stage. Kapp (2012) related a deeper understanding of goals and highlighted the difference between a game and a play—a play transforms into a game once a goal is added to provide a milestone to reach. This is the case in educational games, transferring the educational content into milestones to be reached. Kapp (2012) perceived goals as a measurable outcome of the game. García *et al*. (2017) propounded that a goal represents a challenging target to be achieved with gamification, one that can be evaluated through fulfilling conditions. Kapp (2012) and García *et al*. (2017) related the goals to an evaluation measure. Another representation of gaols is presented in Özdener's (2017) work that applied 'challenges', which referred to tasks that were to be accomplished by students. The significance of players accomplishing the milestones is in the promotion of motivation Landers *et al*. (2017).

Current practices include the work of Browne *et al*. (2014), which suggested differentiating between short-term and medium-term goals of a game and demonstrated the difference through an alternative presentation of the interface. The suggested presentation is a reward element from the author's perspective. Landers *et al*. (2017) suggested that identifying levels for the goals would motivate students.

Similarly, Botha and Herselman (2015) suggested to set the number of goals, each one being associated with a specific badge when accomplished. The research of González *et al.* (2016) designed fitness training programmes and divided each exercise into sub-goals to be achieved, and each accomplished goal has points assigned to it. The relation between goals and rewards is suggested in Browne *et al*. (2014), a more specific type of reward in Botha and Herselman (2015) as badges, González *et al*. (2016) in points. Nonetheless, the reward as an element is discussed independently in Element 12.

There is research that applies the aforementioned concept with no discussion of how it was applied or what its significance is, such as Lameras and Moumoutzis (2015). Additionally, Toda *et al*. (2015) claimed applying goals as a gamification concept. However, there is no discussion of goals or how it was integrated into the system design.

Gordillo *et al*. (2013) suggested a relationship between goals and social engagements, as some goals may require collaboration among players. Social engagement as a gamification element is discussed in Element 11.

Element 3. Rules: set main rules for the game

There is a limited discussion on setting rules as a gamification element in the literature review. Rules are significant in building the game structure and directing the players.

A thorough explanation of the concept is presented in Kapp (2012). The book distinguished four types of rules in a game design context, all of which are described below:

- Operational rule: how the game is played and connects players' actions to result in an event.
- Foundational/Constitutive: a logical and mathematical formula that runs the programming codes and is set by the game designer.
- Behaviour/implicit: the social interaction and communication amongst players. "Rules that govern the social contract between two or more players, in other words the rule related to being a good sport about the game. These rules are game etiquette." (Kapp, 2012, p.278)
- Instructional: this includes general rules that players must embrace as an attitude.

Kermek *et al*. (2016) referred to Rules in their research, which was presented in programming decision support unified Modelling Language (UML) diagram. However, the type of Rules is related to the structuring decision for programming and not the gamification design concept. The work of García et al. (2017) viewed Rules as a set of evaluable actions and could be a form of a mission, player progression status, player behaviour, or temporal constraints.

Goshevski *et al.* (2017) compared five available gamification platforms for educators, highlighting the elements included in each platform, which is called Seppo. The platform won an award in 2017 to promote learning using rules set by teachers. However, this review does not make it clear as to what type of rules can be implemented; it could be a communication rule, navigation, or a simple challenge.

This research adopts Kapp's operational rule concept, which clarifies how the game is played (i.e., the events, actions, and the expected results) (Kapp, 2012).

Element 4. Time: allocating each task a session duration

Timing is significant to allocate the duration of each task; Kapp (2012) pointed out that task duration is a crucial achievement indicator—in a learning session. While it is essential to have enough time to meet the learning goal in each screen, leaving the task without time constraints may lead to a low sense of achievement. Ašeriškis and Damaševičius (2014), which reviewed gamification design patterns in existing systems, found that time constraints were used to motivate players or system users. Therefore, learning games must provide players with a sense of antecedence.

Current practice presented in Browne *et al*. (2014) used a timer on the screen to increase players' focus. The same concept was also referred to as 'time pressure' Toda *et al*. (2015). Faghihi *et al.* (2014) mentioned adding a specific duration for each task, building the game with set timing for an individual learning task, and introducing a practice of a customised task's duration according to an individual student's pace. González *et al*. (2016) stated that timing was one of the gamification mechanics applied in their study as a motivation. Still, it seems that timing was recorded as a means of assessing the health style outcomes and measuring the progress.

In this research, 'time' refers to set a task expected accomplishment time rather than the full game duration.

Element 5. Level: structured levels to provide the player with additional interest to succeed at each level and move forward

The levels structure the game to provide the player with additional interest to succeed and move forward. The significance is to motivate students to progress to the next level, which holds a different learning objective (Melero et al., 2015; Landers et al., 2017). The level has been referred to differently in literature. For example, it has been referenced as 'quests' by Villagrasa and Duran (2013) and Baldeón et al. (2016), 'sub-goals' by González et al. (2016), and 'challenges' by Melero *et al*. (2013) and Goshevski *et al*. (2017).

Numerous references suggest an increase of difficulty in the game's progress as a useful strategy (Pedreira et al., 2015; Senderek et al., 2015; Halloluwa et al., 2016; Markopoulos et al., 2016; ;Landers et al., 2017; Steinberger et al., 2017). This aligns with Browne *et al*. (2014), who designed a game for educational purposes and used the model of flow by Csikszentmihalyi (1997), which is illustrated in Figure 3-10. The same concept discussed is in Dichev et al. (2018), as the game should maintain a flow between boredom and anxiety.

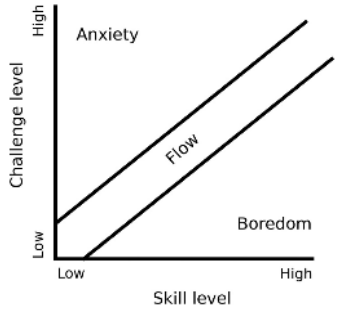


Figure 3-10. Flow Theory of Csikszentmihalyi, Adopted from Browne et al. (2014)

Nunes *et al*. (2016) stated that the games' levels of difficulty are identified by game creators. In pedagogical gamification, this could refer to the teachers or the game developers.

Alternatively, others have used levels to present the progress without difficulty ascending nature, (Toda et al., 2015; González et al., 2016; Heryadi & Muliamin, 2016; García et al., 2017; Pineda-Corcho & Moreno-Cadavid, 2017). Goshevski *et al*. (2017) introduced levels as a type of rewards that implies the place of a player on leaderboards. However, this interpretation is not entirely accurate; levels are to be set separately from rewards, as they represent the milestones of learning objectives. Goshevski *et al*. (2017) compares five available gamification platforms for educators, highlighting the elements included in each platform. One, called ClassCraft, provides an experience point for challenges and considers them as levels. The levels introduced in this paper are not in accordance with the concept proposed in this research. In this research, levels are meant to provide smaller learning objectives for students.

Element 6. Number of players

Stanley (2014) identified the number of players as one of the design requirements.

Element 7. Objects to be added

Sharples et al. (2005) explained designing mobile learning defined objects as an action that fulfils the objectives for the learners. Another use of objects that differs from this research occurs in Noran and Ovidiu (2016), which depicts the use of other gamification elements as 'gamified learning objects'. Börjesson *et al*. (2015) used the term object referring to interface design elements and relate to object-oriented programming.

In this research, the objects as an element adopts the view of Andrade and Law (2018). Andrade and Law (2018) discussed the user interface objects as part of the design. These include buttons on the screen and screen layout.

Element 8. Choosing the multimedia elements such as photo, video, audio, text, and animation

The multimedia choice in learning or gamified environment is an important decision. Kapp (2012) and García *et al*. (2017) referred to the element as 'aesthetics' and connected this with providing a

creative interface design that appeals to users. According to Mayer (2017), integrating multimedia in a computer-based learning system positively impacts the learning outcomes. According to Senderek *et al*. (2015), multimedia used in gamified learning context include text, photo, graphics, video, and audio. García *et al*. (2017) explained the use of multimedia to set the user profile and reflect the learner's progress to build a coherent experience.

Element 9. Controls: user input method (e.g., choosing touch screen or voice command) for output and pupil feedback

Sweetser and Wyeth (2005) indicated that control is a sense to be channelled to the players over the game. In this research, the controls represent the input mechanism used to communicate the interaction between the player and the game, such as keyboard mouse, touch screen, and voice command input. The significance of controls as a design decision is mentioned in Thorpe *et al*. (2011). Heryadi and Muliamin (2016) cited Sweetser and Wyet, (2005) but provided no explanation of the application of controls.

Element 10. Add excitement at certain points of the game

The literature conferred adding excitement under different terms, such as 'challenge' Sweetser and Wyeth (2005) 'curve of excitement' Kapp (2012), and 'unpredictability and curiosity' Chou (2016). Nunes *et al*. (2016) suggested adding a bonus score to the regular points scored as a way to increase students' motivation to play. The significance of this element is to maintain players' enthusiasm during the game in order to increase motivation and engagement.

Sweetser and Wyeth (2005) stated this element as a 'challenge', indicating that the level of challenge should increase according to players' skills at a relevant pace. Kapp (2012) relates the curve of excitement in the process to game designer task and suggested that players at the beginning of the game were always motivated to do training provided by their employers or course leaders. While the player absorption levels through the overall experience may vary, the game designer role is to monitor that excitement level through the game and motivate students to continue playing enthusiastically. Chou (2016) discussed a core of 'unpredictability and curiosity' and acknowledged that adding mystery and promoting curiosity led to better marketing results. Chou (2016) provided a range of mechanics that lead to loyalty and increase time spent on the gamified environment such as lottery or rolling rewards, Easter eggs or sudden rewards, mystery box or random rewards, and glowing choice. However, in an educational context game, the aim is to keep students engaged in comprehending the learning goals of the game not online all the time. This means that these mechanisms require a balance of availability to keep students motivated but not overly fixated on the game. The difference between rewards is what Baldeón *et al*. (2016) referred to as a 'time dependent reward'.

The added excitement may be presented at different points of the game, as a timing rule or bonus temporary levels form one of the gamification elements or a reward. However, the rewards represent Chou's (2016) perception of 'random rewards'. Current literature indicates that maintaining different levels of excitement will accordingly keep players engaged throughout the game.

Element 11.The social engagement

The social engagement plan covers the interaction among players such as collaboration, mentorship, competition, and conflict (Kapp, 2012; Chou, 2016; Özdener, 2017). Chou (2016) addressed possible mentorship, competition, team, and companionship. Villagrasa and Duran (2013) used both collaborative and competitive techniques to build relationships among peers and considered it an appealing strategy to engage students. González *et al*. (2016) provided three modes for the game in their study: individual, competitive, and collaborative. Goshevski *et al*. (2017) identified the existence of social engagement in comparing five platforms—in the form of building teams. However, some allowed cooperation, others promoted competition, and a number offered both. A study about gamification applied the concepts of 'competitions' and 'cooperation' (Özdener, 2017; Toda et al., 2019).

The literature discussed the significance of social engagement as an element in various way. For instance, Simões *et al*. (2013) mentioned the use of teams collaboration to accomplish a task within a gamified educational system. Lo and Hew (2018) suggested that using social interaction among peers in an online flipped classroom enhanced the motivation of the students through the course. de Oliveira and Santos (2016) used team collaboration in collecting points by groups on screen, but the points were not identified as a gamification technique in this work. However, one of the platform screenshots showed individual earnings and group earnings which illustrated a cooperation technique referred to as 'displaying group status'. Markopoulos *et al*. (2016) suggested that community collaboration is the urge for the user to collaborate with other users in order to solve a particular problem. Collaboration may be encouraged by making the completion of a task easier or is simply imposed on the user as part of a change in his/her status. The work of *Tenório et al*. (2016) promoted competition by adding specific rewards for winners in challenges.

There is an intersection between social engagement plan in this context and the social media sharing option. For example Chou (2016) referred to social interaction as a 'brag button' technique and indicates its benefit as providing a way for players to share their achievements on social media in a way that would encourage others to seek progress and share. Similarly, Fitz-Walter *et al.* (2017) mentioned adding friends and the ability to see their achievements and progress. Nunes *et al.* (2016) provided students a way to share points scored in the game on Facebook that led to a significant 68% of the participants sharing their scores. Other research by Simões et al. (2013)

discussed the leaderboard, as players shared their progress on a social platform. This considered in some research as a type of reward, which is discussed in Element 12. Maican *et al*. (2016) linked promoting competition by publishing a leaderboard. Sailer *et al*. (2017) discussed the psychological 'social relatedness' that can be provided through team assembly in order to create a common target for teammates. This gamification element is not discussed individually rather than with few other elements such as having a meaningful story and avatars and a shared goal to support a social connection among players and toward the game.

A different use of the social engagement provided in Kapp explains the interaction between players as 'behavioural rules': "Rules that govern the social contract between two or more players. These rules are game etiquette." (Kapp, 2012, p.278).

The literature indicates the presence of an intersection between a social engagement plan and rewards specifically, points, and the leaderboard. However, this research refers to social engagement as the plan covering the interaction among players such as collaboration, mentorship, competition, and conflict.

Element 12. Reward structure: useful to motivate the players (e.g., points system, badges, or top player list)

The reward structure could be applied through different mechanisms such as points, badges, and a leaderboard, all of which are used to promote extrinsic motivation (Kapp, 2012; Melero et al., 2015; Pedreira et al., 2015; Chou, 2016; Özdener, 2017; Toda et al., 2019). Botha *et al*. (2014) stated that earned badges are referred to as 'progression', which illustrates players' achievement. This has also been referred to as another element feedback Steinberger *et al*. (2017). Pedreira *et al*. (2015) conducted a systematic literature review and summarised that 15 references used a point-based system while only seven used a badges reward system. Pedreira *et al*. (2015) concluded that points were the most popular type of reward used, as badges came in second place. According to *Sailer et al*. (2017), badges and points, as a gamification element, fulfil the players' sense of competency by providing feedback, which advances the task significance for players. Several researchers have used a mix of different reward types. For example, Simões *et al*. (2013) and Villagrasa and Duran (2013) added points and badges. Chou (2016) suggested feedback techniques such as status points and achievement symbols that provide feedback to motivate players.

The work of Ašeriškis and Damaševičius (2014) implemented game points which were collected and different badges assigned to the player. In a study by Naik and Kamat (2015), badges were awarded at the completion of tasks. Moreover, points are collected for different things such as, participating and reading sources and attempts to answer questions.

The leaderboard has been interchangeably regarded as a rewards mechanism and social engagement. In the context of this research, the leaderboard is a reward mechanism used as extrinsic motivation. A discussion of motivation in gamification is provided in Chapter 2 Section 2.4.1. In an article comparing five available gamification platforms for educators, Goshevski *et al*. (2017) highlighted the elements included in each platform, and points and leaderboards are in all five. Badges are a graphical representation of rewards and in Goshevski *et al*. (2017) review is included in three platforms: ClassCraft, Rezzly, and Youtopia.

Some research provides a practice example to apply. For example, Halloluwa *et al*. (2016) established a five-point scoring system presented using stars instead of numbers. Heryadi and Muliamin (2016) measured the score based on variables best score and the best time for each player. Nunes *et al*. (2016) identified criteria to assign points to accomplished levels but giving incorrect answers will result in losing points. Maican *et al*. (2016) added points for completed tasks. In Tenório *et al.* (2016), points were to be collected for the successful completion of tasks and badges for participation. Fitz-Walter *et al*. (2017) built a more meaningful use of the points representing collected coins and could be used in the game as virtual currency to fuel the player's car. González et al. (2016) used a narration of the created Pirate Island story and the theme and continued to use badges reflecting the same pirate theme and badges (e.g., pirate badge, officer badge, captain badge). Other researchers decided that points were collected weekly based on the successful completion of the activity (Toda et al., 2015; González et al., 2016; Landers & Armstrong, 2017; Pineda-Corcho & Moreno-Cadavid, 2017). Other research has mentioned the rewards mechanism (i.e. points, badges) without implementation examples (Faghihi et al., 2014; Lameras & Moumoutzis, 2015).

A consistent description of the term 'leaderboard' is players' positions in the game based on points in relation to other players (Naik & Kamat, 2015; Pedreira et al., 2015; de Oliveira & Santos, 2016; González et al., 2016; Heryadi & Muliamin, 2016; Nunes et al., 2016; Çakıroğlu et al., 2017; García et al., 2017; Özdener, 2017; Peng *et al*., 2017; Landers & Armstrong, 2017; Landers *et al*., 2017; Kintsakis & Rangoussi, 2017). Other researchers including Tenório *et al*. (2016) and Pineda-Corcho & Moreno-Cadavid (2017) have referred to the same concept of leaderboard as 'ranking'. Another expression of the reward concept is 'feedback' Markopoulos *et al*. (2016) and Sailer *et al*. (2017). There are different terms to refer to the same concept. Nonetheless, references relate it to the points collected by the players, which is a reward mechanism that justifies identifying leaderboard as a type of reward in this research. Toda *et al.* (2019) referred to ranking as 'level', explaining that the players' profiles would reflect their levels according to their respective scores.

Similarly, badges are used to reflect the players' achievements da Rocha Seixas *et al*. (2016). In Sanmugam *et al*. (2016), the platform badges could be awarded to individuals and others for

groups. Simionescu *et al*. (2017) implemented a way for students to evaluate peer projects by awarding team badges based on the presentation of a team's work using an online system.

Sanmugam *et al.* (2016) referred to 'leaderboard' as social bookmarking. Maican *et al.* (2016) suggested the benefit of leaderboards in promoting competition. Sailer *et al*. (2017) studied the effect of badges with leaderboards and indicated in their findings that this enhanced players' task in a meaningful way.

Element 13.Replay option: Allows the player to repeat the game starting from the last successful level

Kapp (2012) discussed the replay option as a positive opportunity for the player to revise his/her, and as a game technique to prevent discouragement. In addition, it helps avoid the sense of the rushing to finish the game without benefiting from all learning intended in the levels due to being anxious about failing to complete a given task in the allotted time. Furthermore, experiencing multiple trials to achieve a certain goal creates an arduous sense of victory in the player. The replay option is referred to as 'freedom to fail' by Botha *et al*. (2014), Botha and Herselman (2015) and Goshevski *et al*. (2017). The multiple opportunities to replay the game were present in Goshevski *et al*. (2017), which reviewed two platforms, ClassCraft and Seppo, giving players the chance to resubmit unsuccessful work. Noran and Ovidiu (2016) suggested a positive relationship between replay ability and acceptance of the learning game. Chou (2016) discussed the concept of 'loss and avoidance', the player feeling as though they have lost their achievement in a game, and related the situation to the despair of losing an investment. In order to stop the negative emotions, it is worth considering a replay option from the last successful achievement.

Summary references have agreed on the benefit that providing a replay option will prevent negative emotions and allow multiple trials to support the pedagogical aspect of this research. This element is added to the framework.

Element 14.Learning progression: representing the actual student acquisition throughout the game

Research considers progress bar as important gamification element to present players' status in the game (Lameras & Moumoutzis, 2015; Naik and Kamat, 2015; Chou, 2016).They argued that presenting an individual's accomplishment and the remaining work give an intrinsic motivation to proceed and highlight the sense of accomplishment, which is crucial to promoting players' motivation. The learning progression presentation as a gamification element is also, referred to as 'feedback' Dodero *et al*. (2014). Markopoulos *et al*. (2016) explained that progression is a mechanism which measures the user's percentage of success with regard to the completion of a level. Fitz-Walter *et al*. (2017) suggested using logbooks store the player's journey and

achievements. García et al. (2017) logged achievements on the system for each player. A study by Goshevski *et al.* (2017) referred to progress as quests passed in a game.

Sailer *et al*. (2017) discussed the significance of providing a visual representation of players' progression through games. Steinberger *et al.* (2017) explained that performance feedback is a useful strategy in gamification. In a study by Botha and Herselman (2015), the progress of individuals was presented in a story, as an interactive image illustrating the learning goals on a pathway from the start to the final goal. Every achievement is reflected in the image as a highlighted badge. In summation, presenting the player's performance is a useful motivational strategy. The presentation could be a progress bar, logbook, or an interactive image.

3.6 Key findings of the chapter

This chapter discusses the process of building a novel framework using two models: ADDIE and U-SDLC. The ADDIE model is utilised to simplify the high-level view that includes four stages in the AH-GPD framework: Requirements, Gamification Design, Implementation and Testing, and Evaluation. Gamification Design (Stage 2) is extended to include two units: Educational content/curriculum and Human-computer interaction. The Educational content/curriculum unit represents teachers' input, illustrated in orange, and the Human-computer interaction unit represents game developers' input, illustrated in green. The two units are intended to promote the synergy between the two stakeholders to accomplish the game design. The agility of the U-SDLC model is represented by adding a new layer to the AH-GPD framework to accommodate the complexity of game design task. As illustrated in Figure 3-11, the gamification design has 17 elements, consisting of 14 gamification elements and three HCI elements. The 14 gamification elements are identified using a comprehensive literature review, as discussed in Section 3.5. In the literature review discussed in Chapter 2 Section 2.8.2, the most related existing framework has a different range of supporting elements. For example, Melero *et al*. (2013) used eight elements; Simões *et al*. (2013) used six; Baldeón *et al*. (2016) used 10; and Toda *et al*. (2019) used a table of 17 elements. However, the work of Toda *et al*. (2019) used points, a trophy, and a leaderboard as individual elements, which are referred to in this thesis as one element: reward structure. The subsequent chapters will help distinguish which of the identified 14 gamification elements fall under the domain of teachers or game developers, or if an element is intended to be a shared task. Teachers' validation will be discussed in Chapter 4 and Chapter 5. This is followed by game developers' validation in Chapter 6

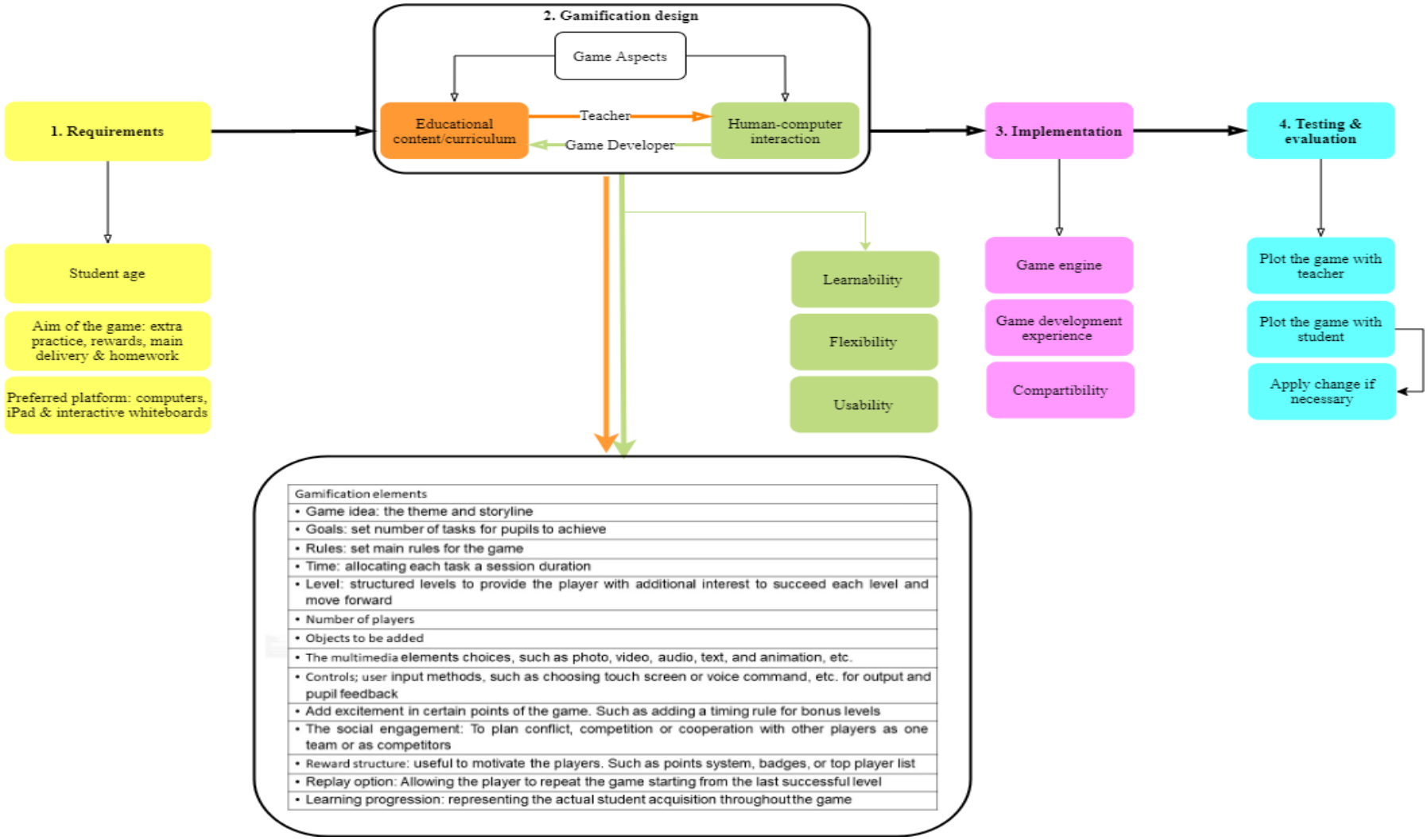


Figure 3-11. The AH-GPD Layered Framework (Version 1)

3.7 Conclusion

This chapter discusses the process of developing an Agile Holistic Gamified Pedagogical Design (AH-GPD) framework based on the secondary resources-literature review. The building of the high-level framework is based on two software design models: Analysis, Design, Development, Implementation, and Evaluation (ADDIE) and Usability-Software Development Life Cycle (U-SDLC), which is discussed in Section 3.3. In addition, this chapter has conducted a comprehensive search to identify the gamification elements in relation to learning, which concludes with various uses of terms such as 'mechanics' and 'dynamics'. The role of gamification elements in this research is to emphasise the ability to use the proposed elements collectively or individually, as discussed in Section 3.5. The identified elements are used to enhance the practicality of the framework and its adaptability by teachers. The literature review emphasises the teachers' integration in the design process, as there is a need to define their role. The following chapter uses a quantitative approach to define the teachers' role in the design process. The validation of Stage 2 of the AH-GPD framework is conducted with teachers to include the 14 gamification elements and is discussed in Chapter 4 and Chapter 5. However, the three HCI elements are game developers' tasks, as the literature review suggests. This is discussed in Section 3.4.2. The validation of the game developers' tasks is discussed in Chapter 6.

Chapter 4. Teachers' Validation of the AH-GPD Framework (Version 2): Survey/Quantitative

4.1. Introduction

This chapter outlines the validation of the proposed Agile Holistic Gamified Pedagogical Design (AH-GPD) framework Version 1 via schoolteachers. The previous chapter discussed building the proposed AH-GPD based on the secondary resources/literature review and emphasised the teachers' integration into the design process. Therefore, this chapter aims to define/understand the teachers' role in the design process by using a quantitative approach to categorise the gamification aspects from a teacher's point of view. This approach consists of two parts: firstly, pilot interviews are used to improve the survey questions and check the clarity of the terms used from a teachers' point of view. Secondly, the online survey is distributed via emails, WhatsApp and Twitter using Qualtrics following a Snowball technique, and the resulting data is analysed using the Statistical Package for the Social Sciences (SPSS).

4.2. Context

This chapter discusses the process of updating Version 1 of the framework and producing Version 2 from the pilot interviews and survey, as illustrated in Figure 4-1. This is a progression in the development of the AH-GPD framework as Version 1 was developed based on the literature review. The literature suggests that gamification should normally be built into the design process, as documented in Chapter 3 Section 3.3.

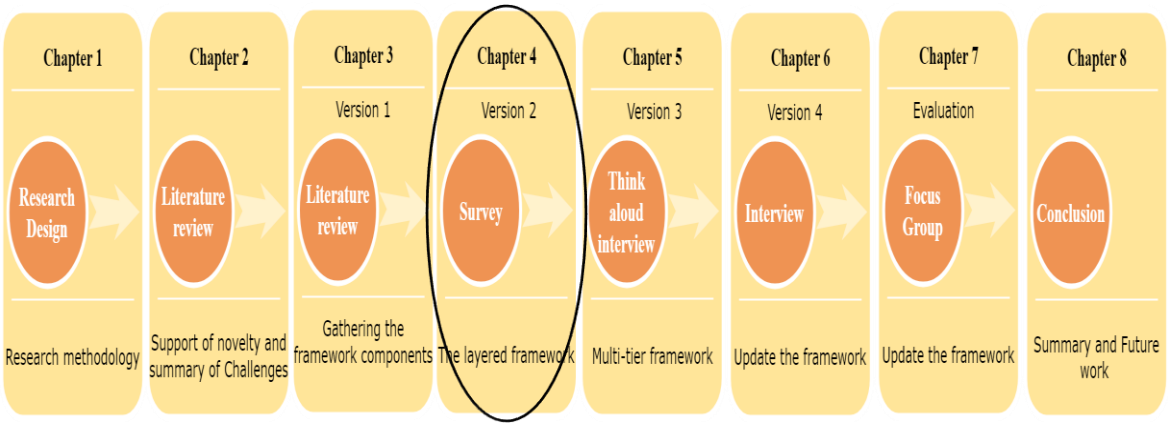


Figure 4-1. Chapter 4 in the Thesis Layout

The framework developed with the literature review at this stage relates the three HCI- identified elements to the game developers, as illustrated in Chapter 3 Figure 3-11. The research contribution here is to clarify the pedagogical aspect in Gamification Design (Stage 2 of the framework). The Gamification design stage includes 17 elements in total, three of which are related to the HCI and

game developers. This initial stage of the primary research placed teachers' perceptions early in the process. For instance, Mystakidis *et al*. (2014) designed a gamified e-learning environment in which interviews with teachers were used to identify the learning objectives in the initial step of the design. Botha and Herselman (2015) described the teacher as the *'content and context expert'* in the process of designing a gamification course supporting professional development. Schulz *et al.* (2015a) investigated teachers' motivations towards e-learning design, and the research suggested that teachers should be more involved in the design process. Experimentation by González *et al*. (2016) regarding influencing healthy lifestyles through active video games incorporated teachers as part of the design team. Markopoulos *et al*. (2016) discussed integrating e-learning and gamification and stressed the benefits of teachers' inputs in organising the course, as discussed in Chapter 2 Section 2.5.

This chapter is composed of four sections, namely, the KSA context, pilot interviews, the survey and the findings from these two parts, as shown in Figure 4-2.

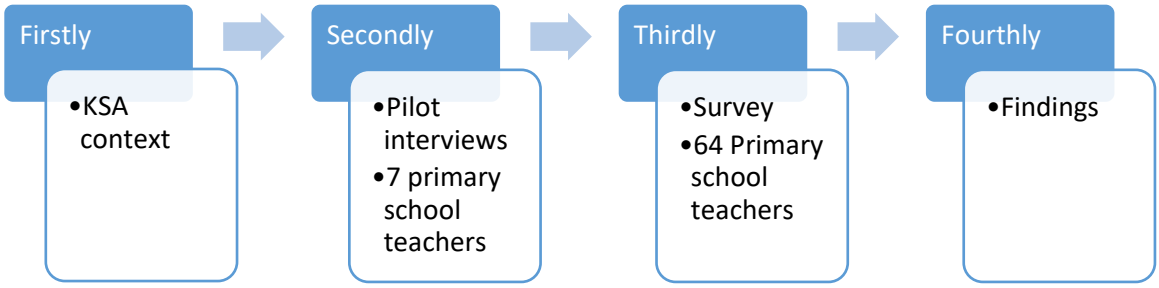


Figure 4-2. Chapter 4 Outline

4.3. Saudi Arabian Context

The Saudi Arabian context has a rising challenge to manage—the anticipated growth of educational institutions, as illustrated in Figure 1-1. According to the Ministry of Education, there is an increasing number of schools in both the public and private sectors. During the 5 years between 2013 and 2018, the number has increased by 931 schools in both sectors, which includes primary, intermediate and secondary schools for students between 6 and 18 years old. As illustrated in Figure 4-3, as of 2018, there were 30,700 schools in Saudi Arabia that cater to students 6–18 years old (Ministry of Education, 2018).

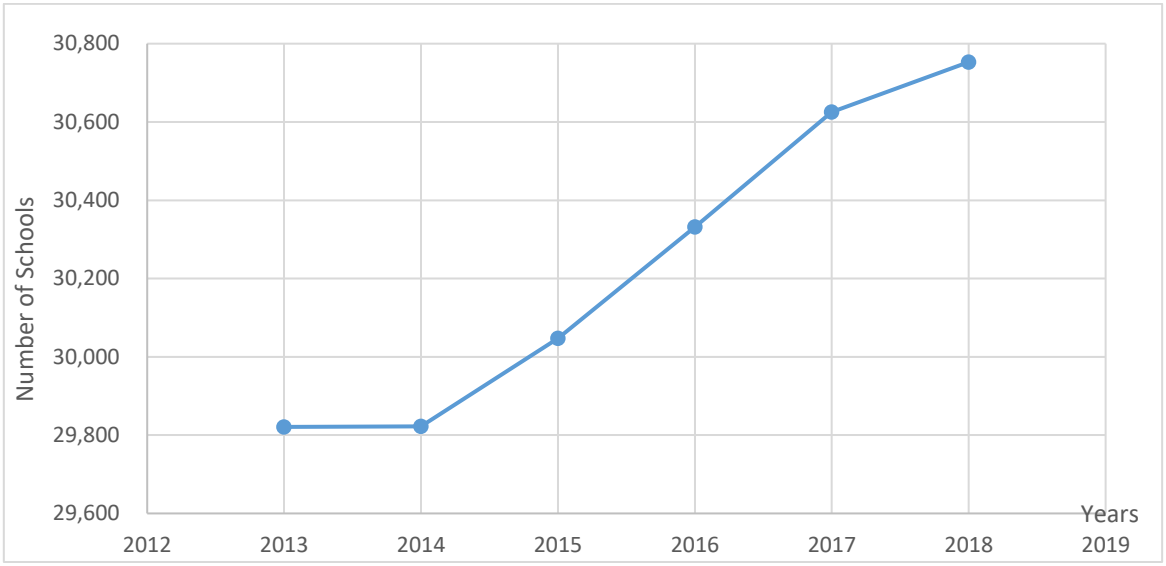


Figure 4-3. The Number of Schools in KSA between 2013 and 2018

The increase in the number of private-sector schools between 2013 and 2018 represents 49% of the overall growth in Saudi Arabia. This increases the possibility of additional contributions of funds from private schools to produce a collaborative platform to gamify the pedagogical content of appropriate lessons. Consequently, there will likely be a growth in the number of students enrolled in higher education, as anticipated by Alwathnani (2020). The growing market for private universities in KSA higher education is expected to increase to 4 million students in the next 5 years. In 2017, a survey on education and training indicated that there were 1,262,687 students in higher education institutions in KSA (General Authority for Statistics, 2017). The number of public universities established in Saudi Arabia has increased significantly between 2002 and 2013, as illustrated in Figure 4-4.

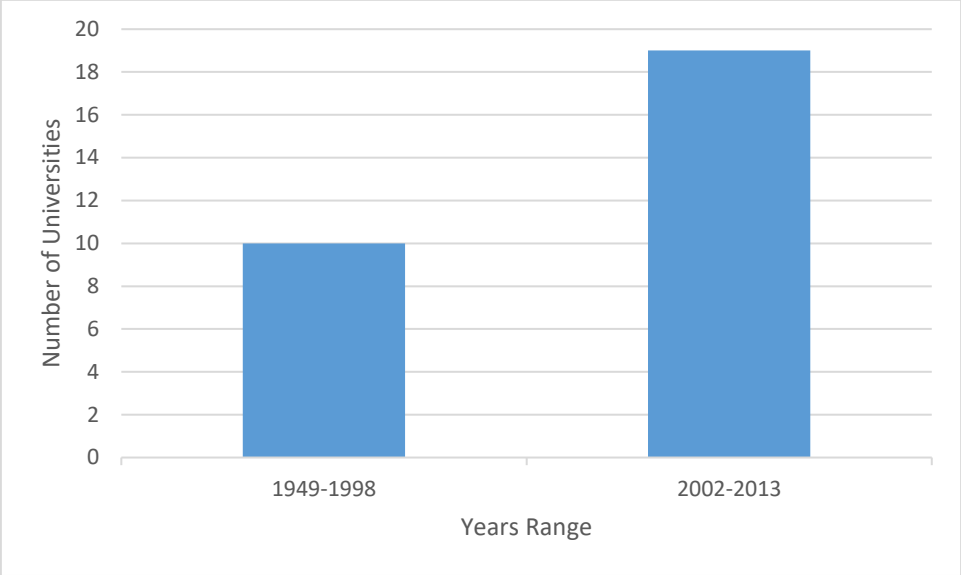


Figure 4-4. The Increase in the Number of Public Universities in KSA

This rapid growth of the number of schools and students indicates the need for contemporary technology adoption to meet these challenges. Therefore, a plan for developing a strategy to manage the increase in enrolment must include integrating digital learning tools.

4.4. Pilot study: Interviews

4.4.1. Overview

The pilot interviews were designed to examine the clarity of the gamification elements before the online survey was distributed to a representative sample. The interview questions are outlined in Appendix D.1. The rationale for using interviews as the piloting approach is that they allow more detailed feedback and interactive discussions with the interviewee, as discussed in Chapter 1 Section 1.6.2.

4.4.2. Discussion and Findings

Pilot interviews were conducted with seven primary school teachers in the UK who taught students at Key Stages 1 and 2 and had varied teaching backgrounds.

The participants' comments influenced some changes in the survey protocol. The comments were as follows:

- All the participants used games in the classrooms but for different purposes. The most common reasons for using games were to reinforce learned concepts, consolidate ideas, deliver parts of a lesson, and in particular, help in mathematics lessons.
- One out of the seven interviewed teachers produced their own computer-based game, and the rest used existing online games.

- Playing online games using interactive whiteboards was the most common delivery platform for many participants because doing so involved the whole class instead focusing on individual activities.
- Some of them raised the issue of iPad availability at school.
- All the interviewed teachers had been using computer-based games for at least half of their careers, which ranged in length from two to sixteen years.
- None of the respondents knew about or searched the literature for guidelines addressed to teachers, in general, to help them produce electronic or computer-based games.
- Rules seemed ambiguous for most participants, pointing to a need for including more descriptive sentences for elements or examples to make the meaning of the elements clear.
- Fourteen gamification elements were identified from the literature review. One of the elements, “Specify the objects to be added", was removed from the list, as the gamification element was not clear to the teachers. Some teachers asked for more clarification, and the researcher explained the element via examples. It seemed to the teachers that the element belonged to multimedia. Therefore, the number of elements was reduced from 14 to 13.
- Originally, a 5-point Likert Scale was designed for categorising the gamification elements (1-- Only teacher-related, 2-- Somewhat teacher-related, 3-- Both equally, 4-- Somewhat Interface designer related, 5-- Only Interface designer related). However, the comments from the teachers indicated that responses 1 and 5 were not appropriate, as it should be a collaborative process. Consequently, responses 1 and 5 were eliminated, and the survey modified to include responses 2, 3 and 4 only, which were renumbered as responses 1 to 3.

In this pilot study, the teachers were enthusiastic about being part of an educational game design team and 1 out of the 7 participants had designed their own e-game. Some teachers implied that producing a game themselves would be a time-consuming task and that they consequently preferred to use the games available online. Furthermore, some teachers indicated their frustration in not finding any guidelines for designing games addressed to teachers, while others had not searched for e-game design guidance. Therefore, this preliminary data suggests the need for design guidelines that support teachers’ requirements and help them gamify pedagogical content.

4.5. Survey

4.5.1. Overview

Following the pilot study, a few changes were made to the survey structure. The changes included adding more descriptive sentences to the elements to keep them clear, and the number of

elements in the categories was reduced to 13, as discussed in Section 4.4.2. The survey aimed to help categorise the gamification elements from a teacher's point of view and refine Version 1 of the framework. The survey was distributed online using the Qualtrics Survey Platform and was available in both the English and Arabic languages for the convenience of the participants, the questions are in Appendix D.2.

4.5.2. Survey design

The survey has four blocks, and each block has several questions, as outlined in Table 4-1. There are 21 questions; however, some of them are not mandatory for privacy reasons. Furthermore, some questions for which a Yes/No answer was requested directed the participant to different parts of the survey according to the answer. Consequently, some participants had fewer questions to answer than other participants. See, for example, Block A Q 8 on the survey.

Table 4-1. Survey Question Design

Block	Content	* indicates non-mandatory questions
	Consent Form	
A	A: Demographic data (8 questions)	1. ID* 2. Gender 3. School name* 4. Sector (Public /Private) 5. Key stage level experience (1/2) 6. Years of teaching experience 7. Subjects taught 8. Use e-games in class (Yes/No)
B	B: Purpose of using games (3 questions)	1. How long have you been using electronic games? 2. What platform are you using? (iPad, Computer, Interactive whiteboard) 3. Guidelines on the platform (Yes/No/Not needed)?
C	C: Developed/Designed game (4 questions)	1. Have you tried to create an electronic game yourself? (Y/N) 2. What program/application did you use? * 3. Have you found any guidelines to help you design games? (Y/N) 4. If yes, please provide details, such as, what the guidelines were and where you found them. *
D	D: Gamification elements (6 questions)	1. What is your purpose in using electronic games? (you can choose more than one answer) 2. If you chose "other" for the previous question, please specify.* 3. How far do you think teachers should be involved in learning game design? (Choose a percentage) 4. Categorise the gamification elements (Teacher, game developer, both equally) 5. Please provide any comments on educational games use at your school.* 6. if you do not mind the researcher contacting you if further information is needed, please include your email. *

4.5.3. Sample size justification

A study suggests that having teachers help produce game designs for primary school students should be the start of a learning journey. Bouzid et al. (2017) conducted an experiment to promote mathematics learning amongst primary pupils using ADDIE model, as discussed in Chapter 2 Section 2.8. Therefore, the current survey targeted primary school teachers. According to the Ministry of Education, the population of primary school teachers in Saudi Arabia for the academic year 2016-

2017 was 193,440 (Education Statistics and Decision Support, 2020). The number of teachers using e-games in classes as part of their teaching strategy has not been identified in the literature. However, the pilot study (discussed in Section 4.4.2) suggested that a low percentage of teachers use e-games. A sample size calculation using a confidence interval of 90% and an error margin of 10% indicated that 68 participants should be used for the survey, as illustrated in Figure 4-5. The suggested participant number was calculated using an online website (FluidSurveys Team, 2014).

Figure 4-5. Sample Size Calculation

Sullivan and Feinn (2012) suggested following the sample size used in similar published work in the field of research. Schulz et al. (2015b) investigated teachers' motivation to use Information Communication Technology (ICT) tools and used 45 teachers for a survey on the topic. Another study in gamification and ICT used a sample of 60 students (Kayımbaşıoğlu et al., 2016). Therefore, this research followed a snowball sampling technique to reach as many participants as possible within the suggested range of 68 participants to the sample size of 45 suggested by Schulz et al. (2015b). Bryman and Bell (2007) explained that the snowball sampling technique involves having the researcher contact a small group of participants and then asking this group to provide more participants through their contacts. Blanche et al. (2006) acknowledged the benefits of this sampling technique in terms of providing an in-depth understanding in qualitative research. Bryman and Bell (2007) argued for the validity of this non-probability sampling method in generalising the results, however; in this research, the experience of the respondents ranged from less than one year to thirty years. Collis and Hussey (2009) noted that research with an interpretivism philosophy, which is the route this research takes, is more likely to use a small sample.

The survey was created online and sent to primary school teachers, and after one week, less than 20 surveys had been completed. Therefore, the researcher contacted more primary school head teachers to encourage them to share the link with their fellow primary school teachers.

Furthermore, the survey was shared on Twitter, as Khatri *et al*. (2015) suggested that social media could be used to reach more participants. The target demography in the Kingdom of Saudi Arabia, which uses Twitter widely, as acknowledged by the Ministry of Communications and Information Technology (2013) and Global Media Insight (2019).

The survey was conducted using the Qualtrics Survey Platform and was available in the English and Arabic languages. An accompanying statement was used to check that the participants were primary school teachers and to obtain the consent of the participants.

There were 269 attempts to complete the survey; however, only 64 survey records were completed. Unfortunately, the number of attempts dropped as the survey blocks progressed, as illustrated in Table 4-2. The number of completed surveys, however, is close to the target sample size, and the percentage of participants who dropped out has been discussed by Lazar *et al*. (2010). Lazar *et al*. (2010) discussed a random sampling example in which 500 people were given the login information for a study. However, 415 responses were logged, of which 230 were **complete responses**, which is about 46 % of the overall population. In this research case, 269 participants viewed the consent form, and 136 filled in the demographic data, as outlined in Table 4-2. The 64 **completed responses** represent 47% of the people who started filling in the survey, which follows a pattern similar to that witnessed by Lazar *et al*. (2010).

Table 4-2. Number of Recorded Responses

Block	Content	Number of records
	Consent Form	269
A	A: Demographic data (8 questions)	136
B	B: Purpose of using games (3 questions)	136
C	C: Developed/Designed game (4 questions)	134
D	D: Gamification elements (6 questions)	64

The reduction justification

There was a significant drop off in Block D, as outlined in Table 4-2. It could be that the teachers were not familiar with the gamification elements, or they felt uncertain about the elements' meanings. Regardless of the final number of participants, this research continued to analyse the data with the limitation introduced by the limited participation in mind. Moreover, this part of the research will require further validation by teachers to consolidate the findings using a different research strategy, such as interviews. This sequence of a quantitative approach followed by a qualitative approach is referred to as the 'explanatory mixed method' by Creswell (2014). When using this method, the follow-up qualitative (interview) data should help explain and provide a more in-depth understanding of the quantitative (survey) findings.

4.5.4. Discussion

The discussion is divided into four Blocks, which follows the survey design.

A. Demographic data

There were 64 completed responses, 32 from males, and 32 from females. All the responses came from primary school teachers, 81% of whom were public school teachers, as shown in Figure 4-6.

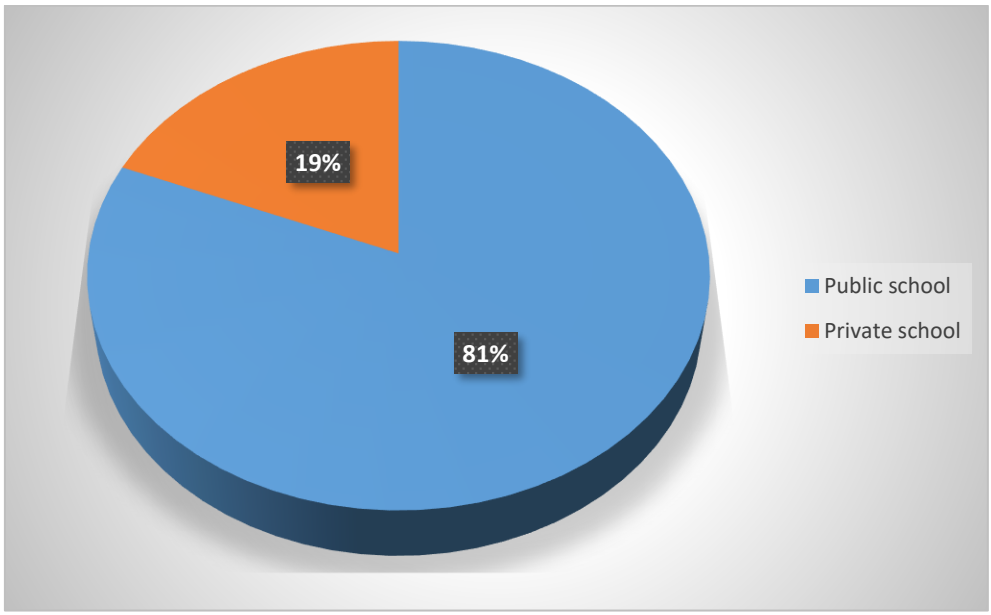


Figure 4-6. Public and Private School Ratio

In the Saudi Arabian education system, primary school has two key stages. Key stage 1 is for students from 6 to 9 years old, and key stage 2 is for students from 10 to 12 years old. As illustrated in Figure 4-7, 55% of the respondents were key stage 2 teachers and 45% were key stage 1 teachers.

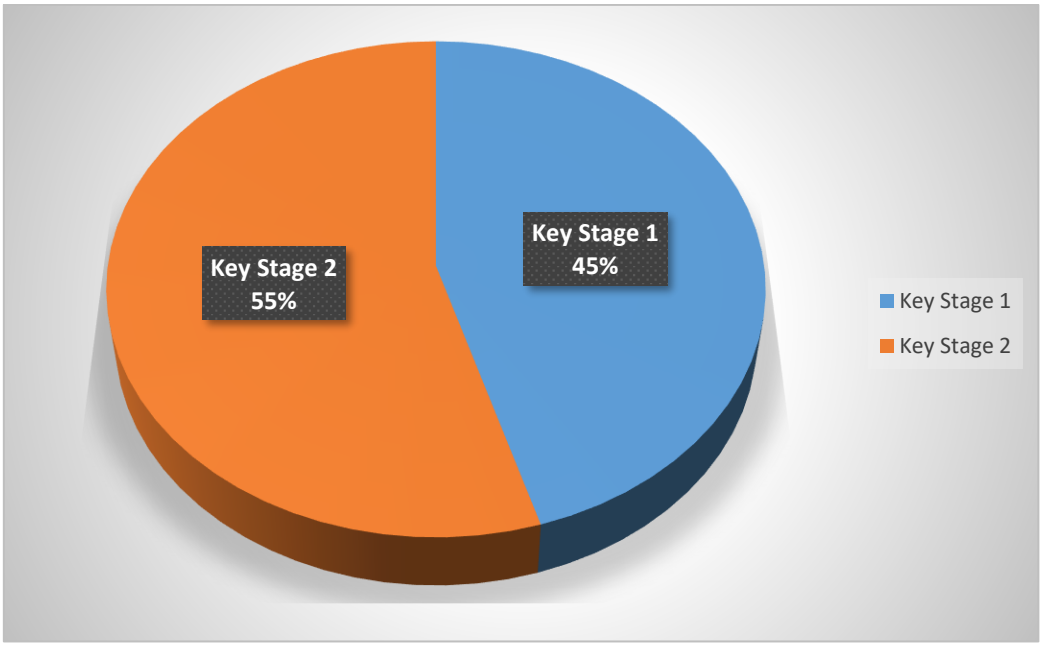


Figure 4-7. Key Stage 1 and 2 Representation in the Sample

Teaching experience ranged from three months to thirty years. The respondents taught subjects spanning the curriculum: Mathematics, Science, Arts, Religious Education, Geography, Arabic Language, Computer, English Language and Family Upbringing Education.

Figure 4-8 indicates that less than half of the participants used e-games. This percentage suggests the limited use of e-games in classes (45%); therefore, the results parallel the drop in the survey respondents at Block D from 136 to 64 (which is a fall of 47%). The majority of the participants who had not used e-games (35) were directed to Block C, and the 29 respondents who had used e-games were directed to Block B.

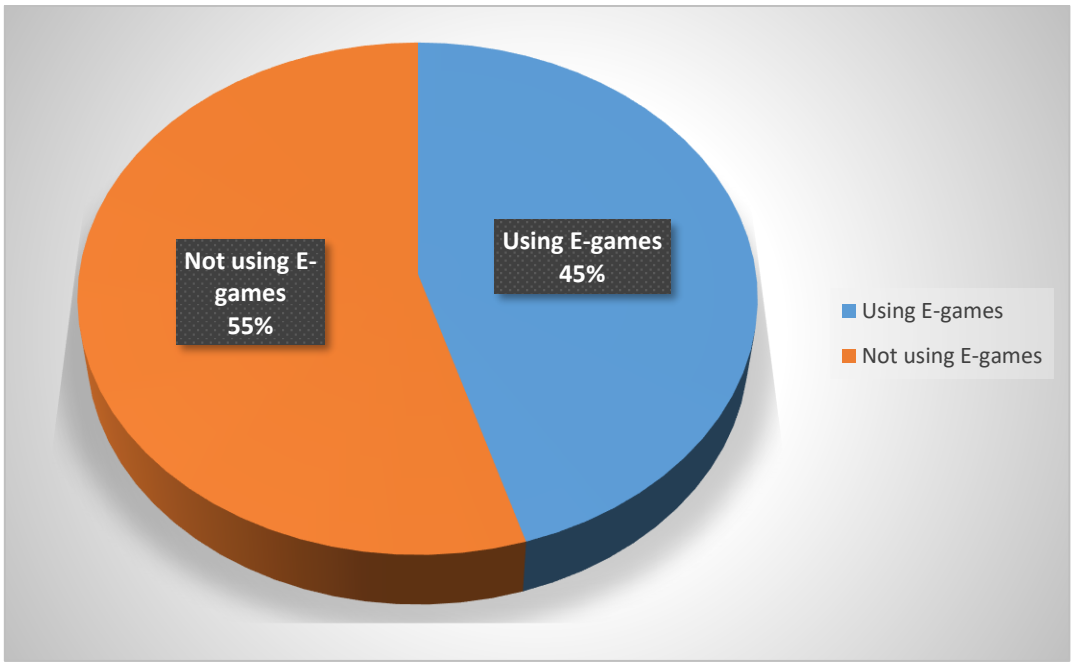


Figure 4-8. The Use of E-games

B. Purpose of using games

Table 4-3 examines the number of years that teachers have been using e-games in class (i.e., the 29 respondents who used e-games). Noticeably, there is a higher percentage of respondents who had been using e-games in the past 4 years, as highlighted in Table 4-3. This increased use of e-games during the last 4 years may be due to the increased exposure to tablets, iPads and smartphones. This question was presented on a numeric scale so that teachers could choose the number of years that they had been using games. Interestingly, one respondent chose 0 years, which presumably meant less than a year.

Table 4-3. Using E-games Duration

Years		Frequency	Percent		Valid Percent	Cumulative Percent
Valid	.00	1	1.6		3.4	3.4
	1.00	5	7.8		17.2	20.7
	2.00	6	9.4		20.7	41.4
	3.00	5	7.8		17.2	58.6
	4.00	6	9.4		20.7	79.3
	5.00	2	3.1		6.9	86.2
	7.00	1	1.6		3.4	89.7
	10.00	3	4.7		10.3	100.0
	Total	29	45.3		100.0	
Missing	System	35	54.7			
Total		64	100.0			

In Figure 4-9 the x-axis signifies the number of years the respondents have been using e-games in class, and y-axis demonstrates the frequency (number of respondents). Noticeably, the frequencies are high for the past 4 years.

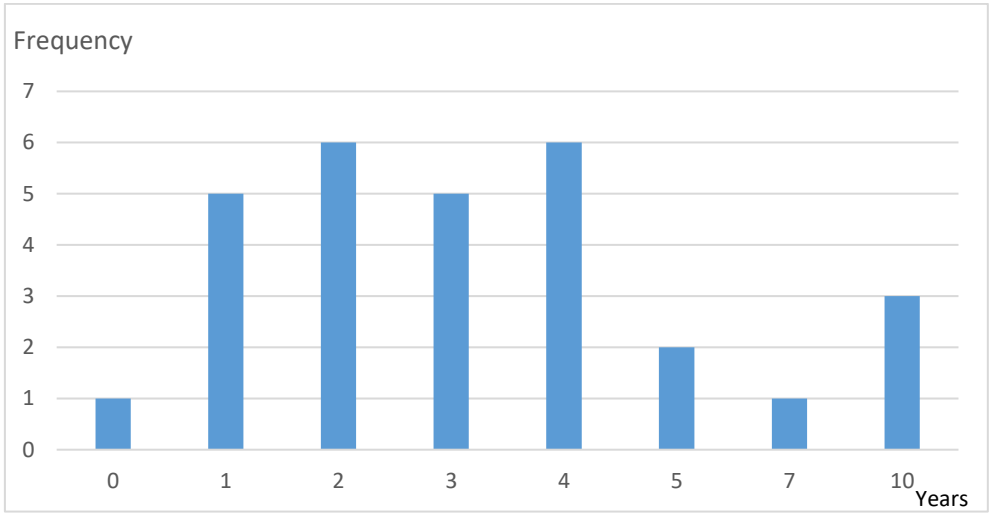


Figure 4-9. Years of Using E-games

The survey provided choices of platforms used in e-games to identify the most used currently. Participants chose Computers, iPads and Interactive Whiteboard respectively, as illustrated in Figure 4-10.

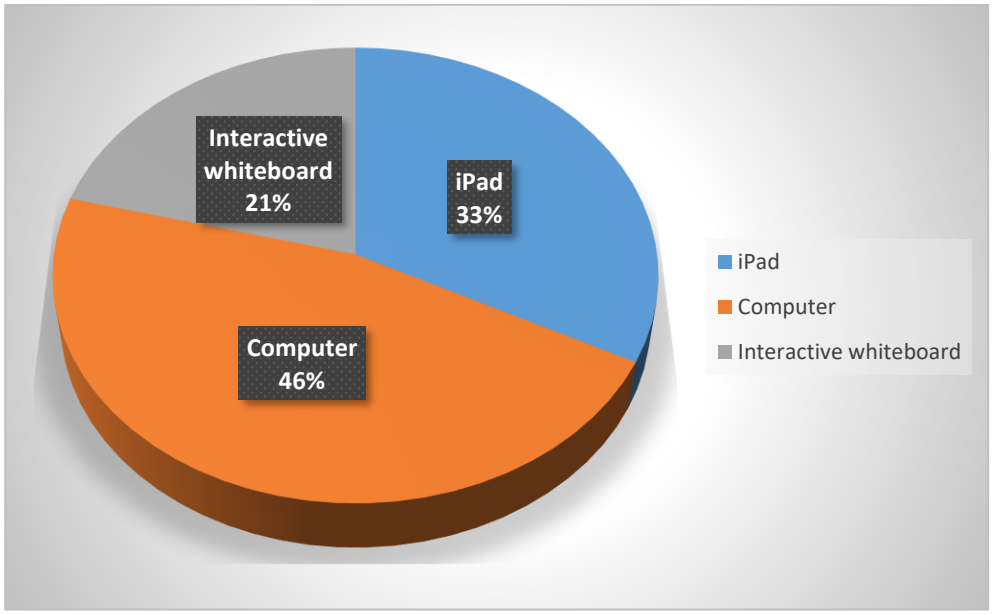


Figure 4-10. Currently Used Platforms

The respondents were asked if they had found guidelines for the e-games /platforms they used, and 13 out of 29 indicated that they did not need any, while 10 of the respondents confirmed that they had found guidelines.

C. Developed/Designed game

Only nine respondents, or 14% of the group, had tried to develop or design an e-game themselves. However, two of these nine respondents indicated that they had tried to develop a physical activity or 'pen and paper' games; consequently, only seven (11%) respondents had actually tried to design e-games.

These seven respondents were asked about the program/application they used to design the game and the answers were Adobe Flash and 3D Game Studio, while one teacher responded with "Times tables", which is the game content rather than the application used.

The respondents were also asked if they could find guidelines that supported them in building e-games, and four out of seven respondents answered yes. One respondent listed three general guidelines with no references "1-- Identify the game objectives for the user; 2-- define a progress indicator so the user knows what he will do next; 3-- for kids, try to use a colourful platform to get their attention". Another respondent stated the "Ministry of Education"; however, I was unable to locate any related information on the Ministry of Education website. Two participants did not provide information and may have forgotten their sources.

D. Gamification elements

The respondents were provided with a list of purposes in using e-games in leaning and were allowed to choose more than one option. The most common purpose was extra practise to enhance students' experiences, followed by reward mechanism, main delivery for the lesson, homework and other, respectively, as illustrated in Figure 4-11. The lowest percentage went to the option 'other', and the respondents were asked to clarify this response. Their answerers were

- "Recap of previous knowledge."
- "To introduce a new topic smoothly and renovate the learning experience."
- "Use of spare time at school."
- "Highly important to increase motivation."
- "After explaining a lesson, it would be a review to help students consolidate their new knowledge."

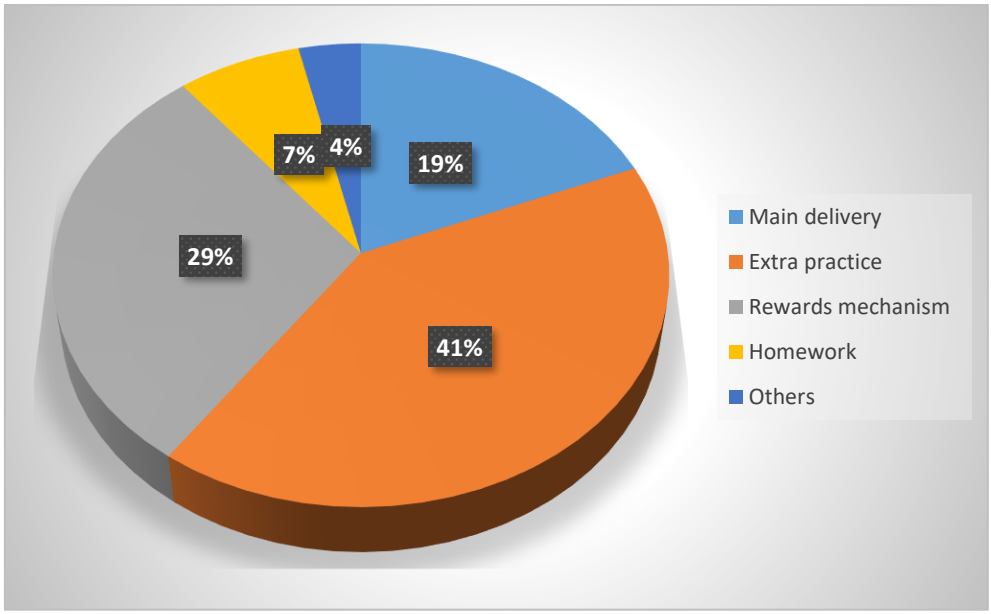


Figure 4-11. Purposes in Using E-games

The following question prompted the respondents to choose a percentage representing teachers' participation in the e-game design process. Their responses ranged from 0 to 100%, with the most frequently chosen percentages being 20 % and 40 %, as illustrated in Table 4-4.

Another way to present this data is to find the frequency in a 10-percentage range, as outlined in Table 4-4. Most of the teachers (73.4 %) identified their role in the design process to be ≤ 50%, as highlighted in Green in Table 4-4, emphasising the technology barrier that teachers may be experiencing or the lack of guidance to support them.

Table 4-4. Percentages Represnting Teachers Participation in Game Design

Teachers' Contribution in the Game Design Process			
Percentage	**Frequency**	**Percent out of 64 respondents**	**Cumulative Percent**
0%	4	6.3	6.3
1%	2	3.1	9.4
2%	2	3.1	12.5
3%	3	4.7	17.2
4%	1	1.6	18.8
5%	4	6.3	25.0
6%	2	3.1	28.1
9%	1	1.6	29.7
10%	2	3.1	32.8
13%	1	1.6	34.4
15%	1	1.6	35.9
16%	1	1.6	37.5
17%	1	1.6	39.1
20%	6	9.4	48.4
25%	1	1.6	50.0
30%	1	1.6	51.6
40%	6	9.4	60.9
41%	1	1.6	62.5
46%	1	1.6	64.1
47%	1	1.6	65.6
50%	5	7.8	73.4
51%	1	1.6	75.0
53%	1	1.6	76.6
59%	1	1.6	78.1
60%	3	4.7	82.8
61%	1	1.6	84.4
66%	1	1.6	85.9
76%	1	1.6	87.5
80%	3	4.7	92.2

Percentage	Frequency	Percent out of 64 respondents	Cumulative Percent
85%	1	1.6	93.8
86%	1	1.6	95.3
95%	1	1.6	96.9
100%	2	3.1	100.0
Total	64	100.0	

The survey includes the 13 gamification elements, which are the uncategorised part of the 'Gamification design' in the framework. The respondents were asked to categorise the gamification elements according to the following three options: teacher-driven task, game developers' task, or shared task. The highest percentage amongst the three options dictated how each element was categorised. Table 4-5 illustrates the gamification elements and highlights their categories. The colour coding follows that for Version 1 of the framework, where orange indicated a teachers' task, green indicated a game developers' task, and a mix of both colours indicated a shared task. For all elements, the categorisation was based on the highest percentage, except in the case of element 10— social engagement. For element 10, the teacher-driven percentage was 40.6%, while the shared task percentage was 39.1 %. Due to the closeness between the two, it was considered as a shared task, as will be further validated in the next chapter. As outlined in Table 4-5, eight elements were categorised as teacher-driven tasks: game idea, goals, rules, time, number of players, choice of multimedia, reward structure and learning progression presentation. Furthermore, three elements were categorised as game developers' tasks: controls, add excitement and replay option. Finally, the shared task categorisation had two elements: level and social engagement.

Table 4-5. Gamification Elements Categorisation

Gamification elements	Percentage		
	Teacher-driven	Game developer's	Shared
1. Game idea: the theme and storyline	64.1 %	10.9 %	25.0 %
2. Goals: set number of tasks for pupils to achieve	70.3 %	10.9 %	18.8 %
3. Rules: set main rules for the game	50.0 %	21.9 %	28.1 %
4. Time: allocating each task a session duration	64.1 %	15.6 %	20.3 %
5. Level: structured levels to provide the player with additional interest to succeed each level and move forward	31.3 %	25.0 %	43.8 %
6. Number of players	48.4 %	15.6 %	35.9 %
7. The multimedia elements choices, such as photo, video, audio, text, and animation, etc.	43.8 %	20.3 %	35.9 %
8. Controls: user input methods, such as choosing touch screen or voice command, etc. for output and pupil feedback	31.3 %	37.5 %	31.3 %
9. Add excitement in certain points of the game. Such as adding a timing rule for bonus levels	25.0 %	50.0 %	25.0 %
10. The social engagement: To plan conflict, competition or cooperation with other players as one team or as competitors	40.6 %	20.3 %	39.1 %
11. Reward structure: useful to motivate the players. Such as points system, badges, or top player list	40.6 %	26.6 %	32.8 %
12. Replay option: Allowing the player to repeat the game starting from the last successful level	26.6 %	42.2 %	31.3 %
13. Learning progression: representing the actual student acquisition throughout the game	50 %	20.3 %	29.7 %

At the end of the survey, respondents were provided with a space to write any comments related to the research topic, and nine participants took advantage of this offer.

- "It needs more time than the class duration, and it is better to prepare the game to explain the lesson and allocate the entire class duration to it."
- "Using electronic games is nice, as this generation tends to use them very much. I hope that we would have lessons in an electronic game form that students love and communicate the learning objectives."
- "To have educational and behavioural goals."
- "In general, the use of electronic games and technology during lessons motivates the students to love the educational material and thus master all the skills easily."
- "Incorporating contemporary ideas that reflect the student's environment, i.e., cartoon films, football players."
- "Comply with ethical and cultural considerations."

- “The game context is very important, having a storyline and focus on the engagement with graphics and sound effects. This would help with students' motivation, specifically low achievers.”
- “The game is a good idea, but I wish that these games would be suggested through education advisors. The available ones have weak content that does not meet students' different levels and does not appeal to them. Also, having games as application easy to download.”
- “We do not have any, and I wish we could use them in the future.”

4.6. Findings of the pilot and survey

This section discusses the findings that were to the pilot and survey stages. The pilot study suggests that teachers are enthusiastic and willing to participate in an educational game design team, while emphasising the importance of the game developer as the person who holds the ICT knowledge. The same sentiment was evident in the survey results, as the majority of the respondents (73.4 %) thought that teachers should participate in 50 % or less of the overall design process/task. Interestingly, the same percentage (14 %) of teachers in both the pilot and survey tried to design their own e-games, suggesting a low level of experience in game design for teachers, which could be the reason why so many teachers dropping out of the survey in Block D, which contains gamification terminology.

During the pilot, some participants indicated that they could not find any guidelines addressed to teachers, while others did not search for any e-game design guidance. This finding is consistent with the survey findings, where no guidelines were suggested/ referenced by the respondents except in one case; in that case, the participant mentioned three general guidelines. The data suggests a lack of guidance to support teachers in gamifying pedagogical content and the need for this research to focus on teachers’ perceptions.

Lastly, the gamification element categorisation done in the survey, which was presented in Figure 4-12, indicated that eight elements were teacher-driven tasks: game idea, goals, rules, time, number of players, choice of multimedia, reward structure and learning progression presentation. Furthermore, the shared task categorisation contained two elements: level and the social engagement. Finally, three elements were categorised as game developers’ tasks: controls, add excitement and replay option. The updated framework presented in Figure 4-10 applies the Stage 2 ‘Gamification Design’ to the diagram and includes the 16 elements. The three elements listed under HCI (Learnability, Flexibility and Usability) were originally assigned as game developers’ tasks based on the literature review and, consequently, were not part of the validation by the teachers, as discussed in Chapter 3 Section 3.4.2. The categorisation of the gamification elements indicates

that eight out of the 16 elements are teacher-driven, following the trend in Table 4-4, which indicates that teachers' participation in the design process should be ≤ 50%.

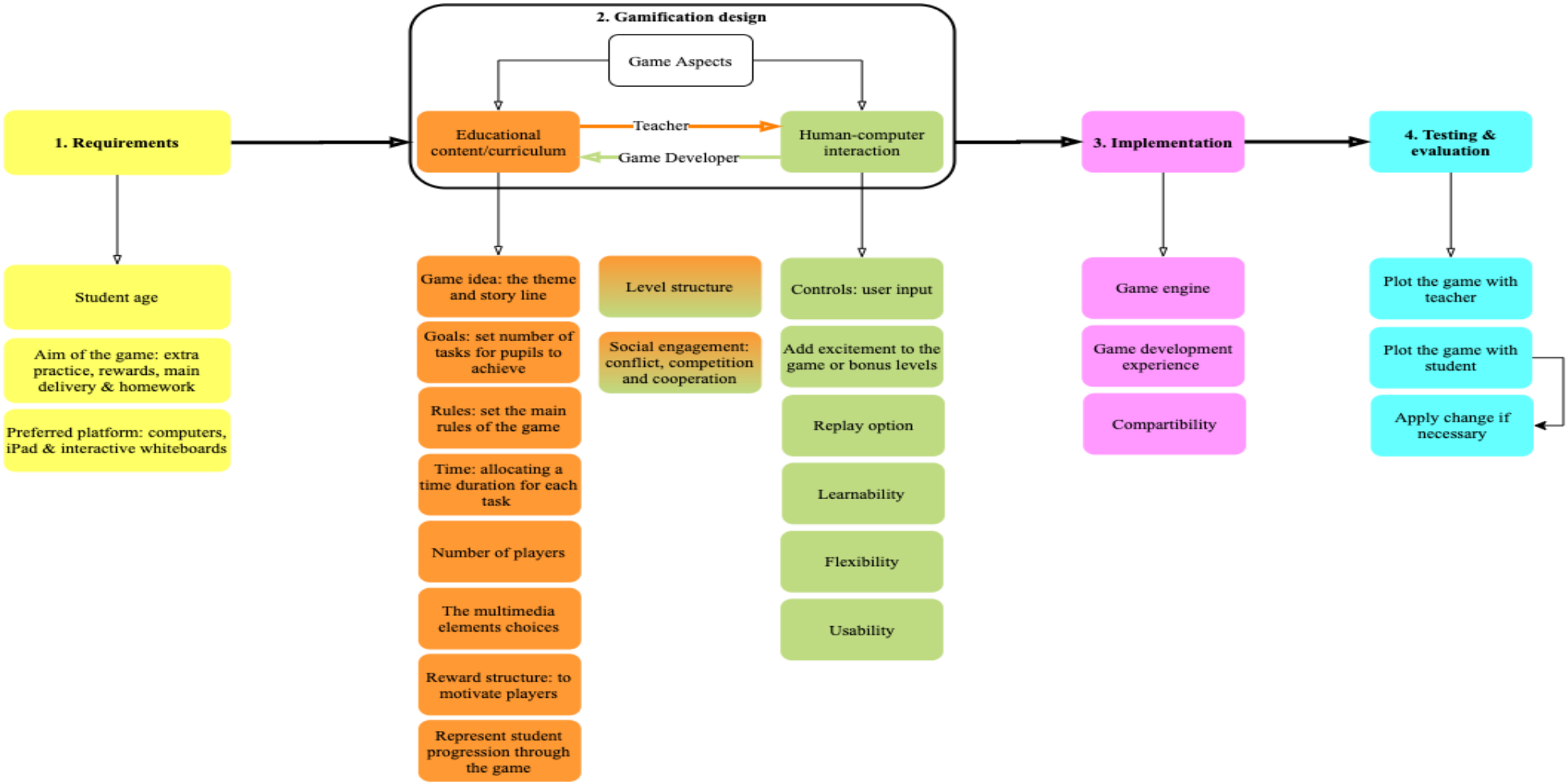


Figure 4-12. AH-GPD Framework Version 2

4.7. Conclusion

The previous chapter presented the AH-GPD Framework (Version 1), which was developed through an extensive literature review. This chapter presented updates to the AH-GPD framework (version 2) as an outcome of the pilot interviews and survey findings that focuses on the Gamification Design Stage. The gamification elements were classified into three distinct categorisations: teacher-driven tasks, game developers' task and shared tasks. The data collection started with teachers initially to emphasise their role in, and focus on, the pedagogical aspect of the research, as discussed in Section 4.2.

The data collection followed a two-stage approach consisting of pilot interviews and then a survey. Firstly, the pilot interviews, discussed in Section 4.3, aimed to improve the clarity of the survey questions. The findings influenced changes. For example, the number of gamification elements included initially was 14, which was reduced to 13 after the pilot due to similarities and overlapping between concepts, as discussed in Section 4.4.2. Secondly, the survey, which was conducted with 64 primary school teachers from KSA, was given, discussed in Section 4.5. The finding of the survey influenced changes in Stage 2 of the framework, that is, 'Gamification Design', as elements were categorised into three distinct groups: teacher-driven tasks, game developers' tasks and shared tasks. The teaches-driven tasks consisted of eight elements, as follows: Game idea, Goals, Rules, Time, Number of players, Choice of multimedia, Reward structure and Learning progression presentation. The shared category had two elements: Level and Social engagement. Finally, the game developers' tasks included three gamification elements: controls, added excitement and replay option. These three elements were added to the three HCI elements identified in Version 1, namely, Learnability, Flexibility and Usability, giving developers six tasks in total.

The results show that teachers have had inadequate game design experiences, as seen in in both the pilot and the survey. This finding could account for the number participants who dropped out of the survey in Block D (50%), where the gamification elements discussed may have reflected unfamiliar gamification terms. Furthermore, the majority of the teachers felt that teachers should participate in ≤ 50 % of the design process, which is reflected in Version 2 of the AH-GPD and depicted in Figure 4-12. The survey findings identified eight out of 16 elements in Stage 2, 'Gamification design', as teacher driven, and two elements were considered by the teachers to be shared with game developers. The survey results also indicated that the game developers should be responsible for six out of the 16 elements (as three elements were already assigned to the game developers as the result of the literature review). Therefore, triangulation will be necessary to explore the teachers' experiences with the game design process and to devise a framework that harnesses their knowledge without a high technology literacy level. Triangulation is used to gather more data that could provide a broader perception (Remenyi, 2012). However, Saunders *et al.*

(2009) referred to triangulation as using different research techniques within one case to confirm/validate the findings. Further discussions on triangulation are found in Chapter 1 Section 1.8.

The next chapter will discuss the validation of Version 2 of the AH-GPD framework with teachers using a qualitative approach. This sequence of a quantitative approach followed by a qualitative approach is referred to as the 'explanatory mixed method' by Creswell (2014). When using this method, the follow-up qualitative (interview) data should help explain and provide a more in-depth understanding of the quantitative (survey) findings.

Chapter 5. Teachers' Practical Validation of the AH-GPD Framework (Version 3): Interview/Qualitative

5.1 Introduction

The previous chapter presented Version 2 of the Agile Holistic Gamified Pedagogical Design (AH-GPD) as an outcome from a survey of primary school teachers involved in categorising the gamification elements. The supported categorisations are: teacher-driven, game developer-driven, or shared task. This chapter continues the validation from a practical perspective for the gamification elements utilising a qualitative approach. The outcome of this chapter is an update to the framework that resulted in Version 3 of AH-GPD—it identifies sub-elements that support the framework's practicality for teachers. The identified sub-elements enhance the agility of the framework to accommodate various levels of teachers' computer literacy.

5.2 Context

This chapter discusses the process of validating the practicality of the framework through interviews with teachers in the Kingdom of Saudi Arabia (KSA). The findings led to the creation of a new layer to the framework and an update for AH-GPD Version 3, as illustrated in Figure 5-1.

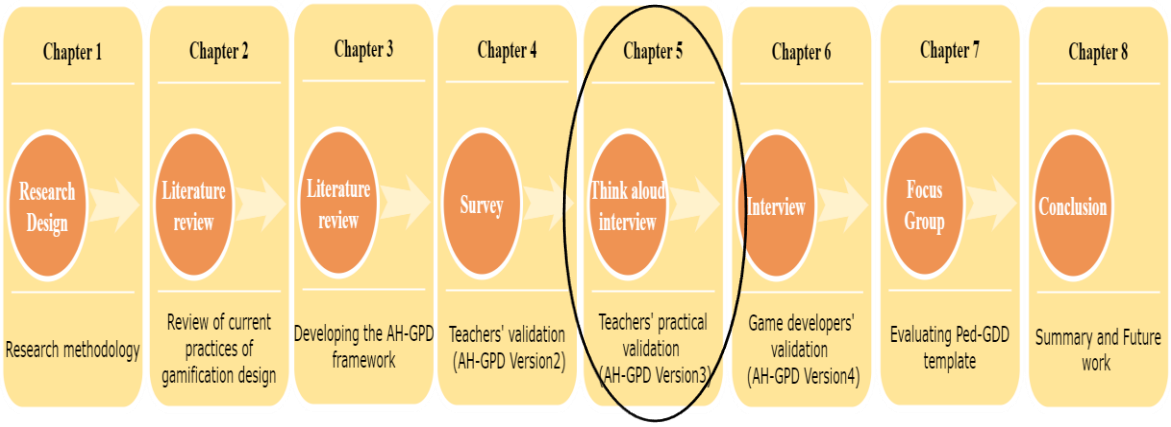


Figure 5-1. Chapter 5 in the Thesis Layout

This chapter is divided in three parts: firstly, an initial pilot interview; secondly, the 'think aloud' interview protocol; and finally, a discussion of both stages of interview findings, as illustrated in Figure 5-2. The initial pilot interview was conducted with two interviewees (i.e. teachers, as outlined in Section 5.3). A primary analysis of the first two interviews showed that the interview procedure was non-productive and the design of the experiment was challenging; unfortunately, it did not provide the expected outcomes. Based on the findings from the pilot study, a refined procedure where the interview followed a 'think aloud' interview protocol was implemented; this protocol is explained in detail in Chapter 1 Section 1.6.3. The change to the interview technique was used to conduct Stage 2, which is outlined in Section 5.4.

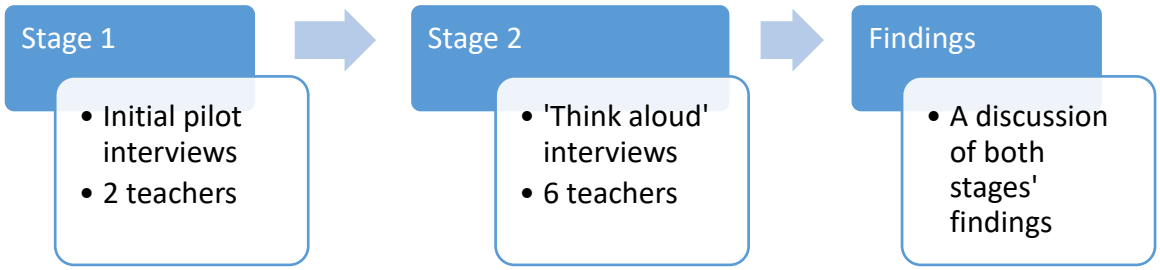


Figure 5-2. Chapter 5 Outline

A challenge of this part of the research involves recruiting participants, as teachers were concerned that they may be evaluated on their ICT skills rather than according to the proposed framework. To alleviate this concern, the participants in both stages were constantly reminded that the interview is intended to evaluate the framework as a design tool that helps teachers. The research scope included diverse experiences of teachers at different school levels that includes different levels of teaching experience and majors (Arts, Science, etc.), as discussed in Section 5.4.3.

5.3 Initial Pilot Interviews: Stage 1

5.3.1 Overview

This section discusses the responses given by the two participants in the initial interviews and explains how the findings were used to refine and improve the validation approach. The initial pilot interview aimed at two goals: firstly, to highlight the proposed AH-GPD framework's (Version 2) strengths and weaknesses from the teachers' perspectives by comparing the framework with two more educational game design frameworks; secondly, to evaluate the practicality of the Version 2 framework by asking teachers to identify game requirements. For the reasons discussed in this section, the initial approach of the validation was revised, and the two interviews were treated as a pilot study.

The revised aim of the initial study was to improve data collection for the next stage, in line with Guest *et al.*'s (2012) perception that a pilot study in qualitative research is beneficial to confirm that the outcomes will fulfil the aim of the main study. According to Charters (2003), qualitative research can be conducted with a minimum number of participants—even just one. However, Charters also pointed out that studying more participants will help to include a wider variety of perspectives. This initial study was conducted with two participants, which satisfies the revised aim and improves the interview approach of the main study. The initial study used a semi-structured interview to allow participants to ask follow-up questions and to provide clarification or reasons for a particular response. A broader discussion of the semi-structured interview as a research tool is presented in Chapter 1, Section 1.6.2.

5.3.2 Discussion

The initial pilot interview discussion is outlined in four parts, as illustrated in Figure 5-3. The initial study involved two participants. Both participants were fully aware of the study aim, which was to validate the framework and not to evaluate their skills. It was noticed in the course of the study that participants felt uneasy about the choices they had to make in Part 3, and questioned their choices at a later part of the interview, which is discussed in Part 4.

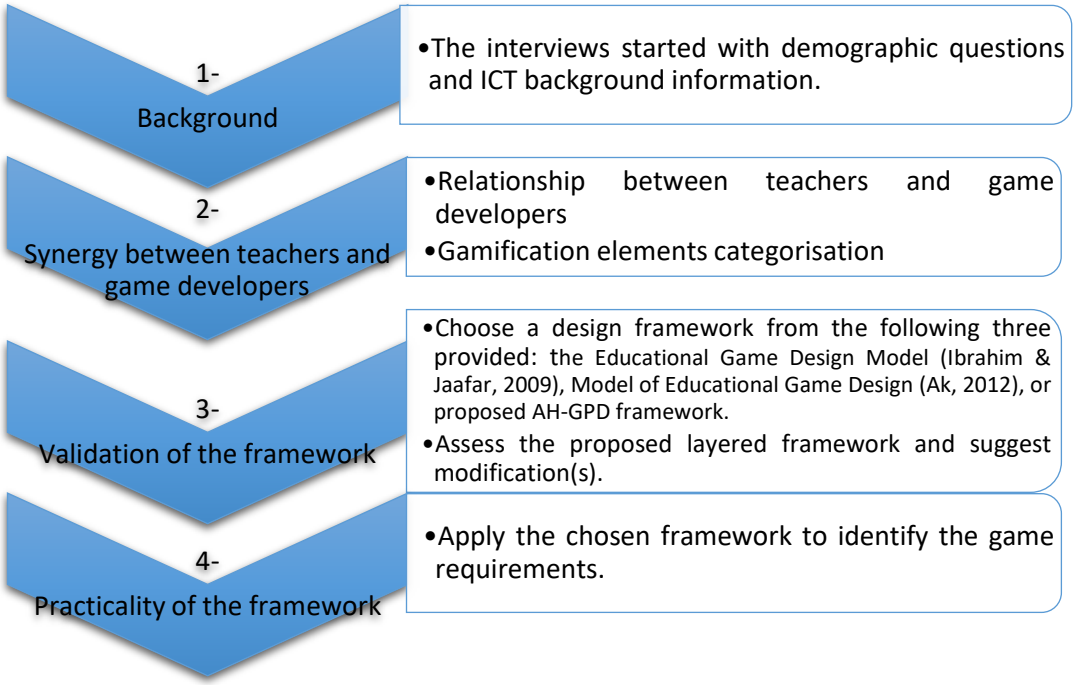


Figure 5-3. The Four Discussion Points of the Initial Pilot Interview

The **first part of the initial pilot interview**, as illustrated in Figure 5-3, began by asking demographic questions and obtaining ICT background information from the participants. One participant did not use electronic games in class but used board games and craft activities (e.g. building blocks to illustrate addition, or play dough to illustrate division). The other participant used electronic games in class. When the participants were asked about the possible uses of electronic games in class, both chose learning games to provide extra practice for students to consolidate the lesson's outcomes. Both participants identified that having a 'Smart Board' in class had a positive effect on technology integration, which would make it easier to use electronic games in class. Neither participant had designed a game themselves, and both expressed the need for training sessions, specifically for game design. According to Aguilar (2019), there is a lack of teachers training material to enable technology adoption.

The **second part of the initial pilot interview**, as illustrated in Figure 5-3, discussed the synergy between teachers and game developers. The participants were asked to give their opinions on the

relationship between teachers and game developers in a game-design process. Both participants defined the relationship with the game developers to build an educational game as collaborative. Then, the participants were asked to categorise the 13 gamification elements used in the framework (discussed in Chapter 4, Section 4.5). The three categorisation options (see Table 5-1) were outlined for discussion as follows:

- Teacher-driven (highlighted in orange),
- Game developer-driven (highlighted in green), and
- Shared task (highlighted in gradient of orange and green).

Both participants expected educational game design to be a collaborative process; the significance of the categorisation was to establish the level of consistency between the two participants' decisions. Interestingly, the two participants identified the same category for 7 elements out of the 13, and the remaining 6 elements were categorised differently by the two participants, as demonstrated in Table 5-1 . The matching categories included teacher-driven, game developer-driven and shared. Out of those seven, the only element both participants categorised as a game developer's task is controls (i.e. input method), which is circled in Table 5-1. The number of unmatched categories suggested the need for another way to configure the relationship between teachers and game developers in the design process using the gamification elements.

Table 5-1. Initial Pilot Participants' Categorisation

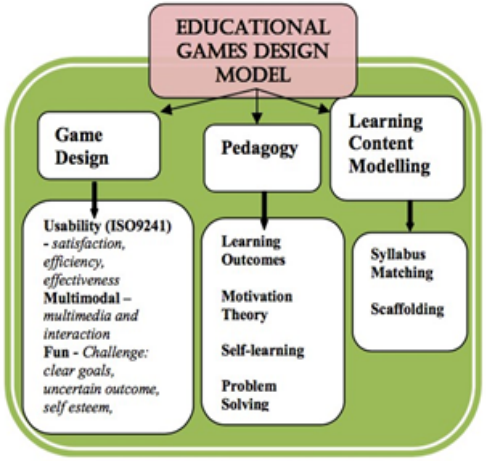
Gamification elements	Participant 1	Participant 2	Matching choices
• Game idea: the theme and storyline			✓
• Goals: set number of tasks for pupils to achieve			✓
• Rules: set main rules for the game			✓
• Time: allocating each task a session duration			
• Level: structured levels to provide the player with additional interest to succeed each level and move forward			
• Number of players			✓
• The multimedia elements choices, such as photo, video, audio, text, and animation, etc.			
• Controls; user input methods, such as choosing touch screen or voice command, etc. for output and pupil feedback			✓
• Add excitement in certain points of the game. Such as adding a timing rule for bonus levels			
• The social engagement: To plan conflict, competition or cooperation with other players as one team or as competitors			
• Reward structure: useful to motivate the players. Such as points system, badges, or top player list			✓
• Replay option: Allowing the player to repeat the game starting from the last successful level			
• Learning progression: representing the actual student acquisition throughout the game			✓

Alternative way of establishing the synergy between teachers and game developers is to discuss the categorisation of each participant individually. The significance of the categorisation is to measure the level of delegation that each participant assigned to the game developers. The first participant categorised one element as a game developer's task and four elements as shared; the

remaining eight elements were identified as teacher driven. The second participant categorised one element as a game developer's task, eight elements as shared and the remaining four elements as teacher driven. There is a clear difference between the two participants in the number of elements that are part of teachers' or shared tasks. The two participants had different views on the number of elements that were the responsibility of the game developers, regardless of the teachers' initial matching expectation of a collaborative process with the developers. After reviewing the data in two ways, the collaboration perception agreement in both participants' discussions was partially reflected in the categorisation of the gamification elements. The variation indicates different levels of expected collaboration; therefore, there is a need to map the interaction and synergy between teachers and game developers in a different way.

The **third part of the initial pilot interview**, as illustrated in Figure 5-3, aimed to validate the proposed AH-GPD framework. The two participants in the initial study were asked to look at three educational game design frameworks, represented in Figure 5-4; the design tools used were the proposed AH-GPD framework, the educational game design model by Ibrahim and Jaafar (2009) and the model of educational game design by Ak (2012). The latter two models were discussed in Chapter 2, Section 2.8. The AH-GPD framework is Version 2 of the development that is presented in Chapter 4, Figure 4-12. The reason for choosing the two educational game models is that they are the only ones to provide pedagogical context with a high-level view from the initial literature search conducted in 2017 (as discussed in Chapter 2, Section 2.6). During the pilot study, it became apparent that teachers needed more detailed guidance in the gamification design. The pilot interview questions can be found in Appendix E.1.

The Educational Game Design Model (Ibrahim & Jaafar, 2009)



Model of Educational Game Design (Ak, 2012)

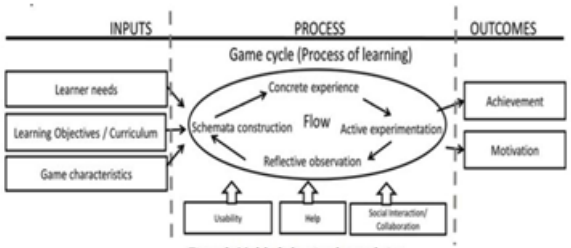


Figure 2: Model of educational game design

AH-GPD Framework (Version 2)

Figure 5-4. Educational Game Design Tools

The participants were asked to compare the provided design framework elements, giving their opinions of the strengths and weaknesses, and to choose one of the frameworks to design a game. The significance of this step is to provide a critical appraisal and suggest improvements to the proposed AH-GPD framework. Therefore, the feedback from this part of the interview was to prepare the participants to see the framework as a design tool from a practical point of view. Both participants chose the educational game design model by Ibrahim and Jaafar (2009) to design a game. The participants justified their choices due to their familiarity with Ibrahim and Jaafar's (2009) model and with educational terminology, such as pedagogy, learning outcomes and syllabus matching. In relation to the proposed AH-GPD framework, the participants indicated that addressing the teachers' role before the game developer role made a positive impression. However, the participants did not have sufficient knowledge of the game-development process to assess the strengths and limitations of the AH-GPD framework. In fact, both participants found the details to be complicated and distracting.

The **fourth and last part of the initial pilot interview** assessed the practicality of the proposed AH-GPD framework. This involved comparing the elements of the provided design frameworks to give their opinions of the strengths and weaknesses, and to choose one of the frameworks to design a game. The significance of the comparison is to indicate features from the other frameworks to be integrated into the AH-GPD framework for this research. The participants' requirements were limited to the learning objectives and not to any gamification-related details. This emphasised that the participants are more comfortable around the things that resemble learning preparation material and familiar terminology that they use as teachers on a daily basis, as they clarified previously in Part 3 of the interview. Also, it suggests that gamification-related details that have technological attributes might intimidate the teachers. After examining the frameworks, when the teachers were asked to do the practical task, they went back to the frameworks and tried to take elements from different models. Although the participants decided and justified their choice from their perspective, they were struggling to apply their choices in practice and to identify basic game requirements. The participants used a few elements from their initial choice and started to express doubt about their selection of a suitable framework, which represents their lack of confidence. At that point, the participants were reminded that the interview aims to validate the framework and were assured that the research does not seek to evaluate their skills. Then, the participants went back to the three options of frameworks, represented in Figure 5-4, and changed their decision to an alternative design framework (this was an iterative process); ultimately, they used a few elements from the other two frameworks. As a result, the list of requirements produced by the participants was inconsistent and incoherent, being produced from the three design frameworks. The researcher observed how the two participants tried to identify the requirement and appeared

to struggle with translating the abstract concept of the framework into a practical design. Therefore, the researcher decided to remove the comparison part of the study due to the confusion and the lack of confidence that led to changing the focus to collect as many details and as much feedback as possible on the framework proposed in this research. The focus would be on the Gamification Design (Stage 2 of the AH-GPD framework), as it represents the collaboration between teachers and game developers, which is the aim of this research.

5.3.3 Findings

The participants initially claimed confidence in planning the game design, however, that was not mirrored in the rest of the interview. Observing the participants attempting to identify a game requirement demonstrated the need for guidance. This was reflected in the participants' attempt to set the requirements combining elements from more than one game design framework, which led to inconsistent and incoherent requirements lists. Therefore, the comparison amongst three design frameworks, which was intended to provide a richer approach, did not help to promote the critical appraisal or suggest improvements.

The participants found it difficult to apply gamification elements in their game requirements, suggesting that high-level frameworks do not provide sufficient guidance. Therefore, the interview process was altered to focus the validation on the Gamification Design (Stage 2 of the AH-GPD framework), as shown in Figure 5-5.

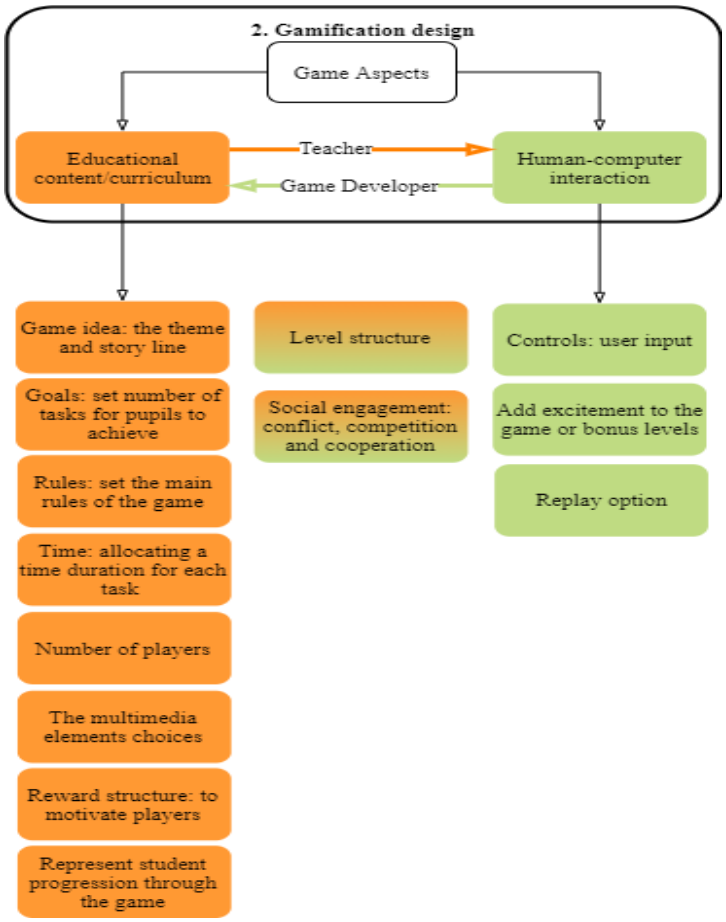


Figure 5-5. Validation Interview's Focus

The outcome of the initial pilot interviews (Stage 1) influenced the following stage and resulted in five changes:

- Remove the comparison amongst three design frameworks and concentrate on the AH-GPD framework.
- Shift the interview from high-level assessment to providing detailed guidance. The details will add to the practicality of the gamification elements, which represents most of the Gamification Design stage components of the framework, as illustrated in Figure 5-5.
- In the practical task, the teachers were asked to identify game requirements; unfortunately, their outcomes were limited to stating objectives, which did not provide feedback on the framework or its elements. Therefore, an interface sketch of task design might be a thought-provoking alternative to provide a practical assessment.
- The framework should adapt to different levels of computer literacy, as participants expressed their comfort around familiar terminology that relates to their pedagogical background.
- Adopt the think aloud interview protocol to gain instant, spontaneous and reliable feedback (Charters, 2003)—in this case, feedback on the practicality of the gamification elements included in the framework. The adopted protocol facilitate observation of

participants' utilisation; the discussion of the think aloud interviews protocol and its benefits is provided in Chapter 1, Section 1.6.3.

5.4 Think Aloud Interview Protocol: Stage 2

5.4.1 Overview

The findings from the initial pilot study, discussed in Section 5.3.3, influenced the design of this stage and altered the semi-structured interview style into a think aloud interview. The think aloud protocol integrates the observation technique within the interview to produce a rich approach and provide comprehensive interpretations of research through spontaneous reactions from the participants (Charters, 2003; Dix et al., 2004 ; Lazar et al., 2010). Johnsen *et a*l. (2016) used the think aloud protocol to follow participants' cognitive process and thinking strategy. The discussion of the think aloud interview protocol as a research tool was provided in Chapter 1, Section 1.6.3. This stage of the research used the think aloud interview protocol with six participants. The researcher prompted the participants, in this case teachers, with questions when necessary and encouraged participants to express their opinions and provide feedback. The observation technique was used to facilitate the practical validation of the gamification elements from the teachers' perspective. A sketch of an educational game interface draft by the teachers, instead of a list of requirements (as used in the initial study), is referred to as the *task design* in the following discussion.

5.4.2 Design

The interview design has three parts, which are outlined in Figure 5-6. The think aloud interview questions are outlined in Appendix E.2.

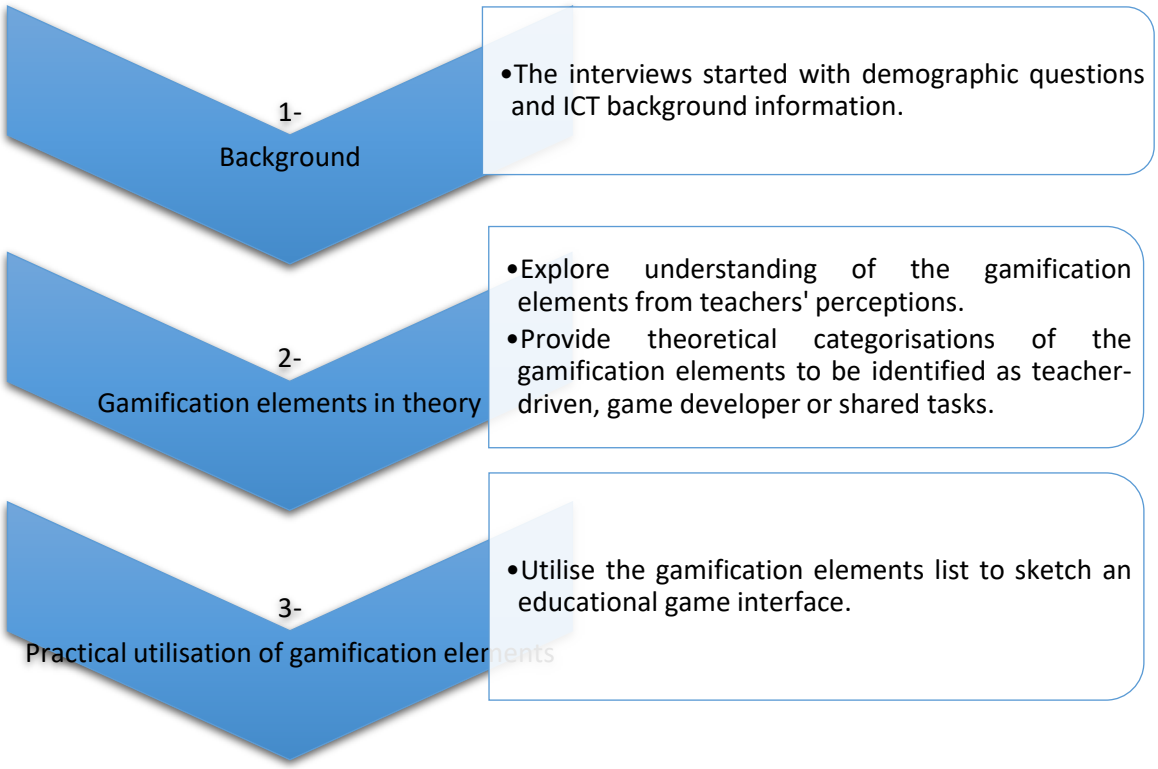


Figure 5-6. The Three Parts of the Think Aloud Interview Design

Part 1 of the think aloud interview, as illustrated in Figure 5-6, discussed the ICT background of the teachers and their teaching experience.

Part 2 discussed the conceptual understanding of the gamification element from the teachers' perception. Furthermore, this part included in-theory categorisation where participants identified the gamification elements as teacher-driven, game developer-driven or shared tasks.

Part 3 discussed the participants' practical utilisation of the gamification elements through the task design (sketch). The participants were asked to sketch an educational game interface and were provided with the gamification elements list, rather than the framework diagram. The gamification elements list was availed to the participants without colour coding to avoid influencing the participants' decision, as illustrated in Table 5-2. The researcher periodically drew the participants' attention to the gamification elements list to proceed with the task design. Participants were informed that the quality of the drawings and their sketching skills were not the aim of the study and would not be evaluated. Participants were encouraged to express their thoughts at the moments of doubt and discontinuity, such as the extended posing of prompting questions to provide clarification when the participants showed a need for guidance.

Later, the six interviews were transcribed, taking note of any frustration or confusion a participant encountered during the experiment.

Table 5-2. Gamification Elements List

Gamification elements
• Game idea: the theme and storyline
• Goals: set number of tasks for pupils to achieve
• Rules: set rules for the game
• Time: allocating each task a session duration
• Level: structured levels to provide the player with additional interest to succeed at each level and advance
• Number of players
• Choices of multimedia elements, such as photo, video, audio, text and animation, etc.
• Controls: user-input methods, such as choosing touch-screen or voice command, etc., for output and pupil feedback
• Added excitement at certain points of the game, such as adding a timing rule for bonus levels
• Social engagement: planned conflict, competition or cooperation with other players as one team or as competitors
• Reward structure: used to motivate the players, such as a points system, badges or a top-player list
• Replay option: allowed players to repeat the game, starting from the last successful level
• Learning progression: represented student acquisition throughout the game

5.4.3 The participants

In this part of the research, recruiting participants was a challenge as the interview required more than 30 minutes. Six teachers volunteered to participate, and they had varied experience in teaching different age groups, as well as different professional experience that ranged from 1 year to 25 years. Participants represented a varied background in their qualifications, and their college majors varied from Humanities to Art to Linguistics. A summary of the participants' profiles is outlined in Table 5-3. Bryman and Bell (2007) mentioned that a representative group can be obtained through 'convenience sampling'. (Silverman, 2013) emphasised that, in qualitative research, an interview utilises open-ended questions and a limited number of participants, and

Lazar et al. (2010) suggested that five is a "sufficient number of participants" (Lazar et al., 2010, p. 263).

The measure of participants' experience used in the analysis was determined by the researcher rather than the individuals' self-assessment. The rationale for this is that participants from the initial study overestimated their skills, which was not reflected in the practical task design. In this part of the study, the researcher used other elements to determine participants' familiarity with gamification design. The assessment elements are the history of using IT in class, the use of electronic games and previous experience in designing an electronic game. Below, the participants are referred to as P1 to P6.

Table 5-3. Participants' Profile Summary

Participant number	Teaching experience (in years)	Age group taught	Using IT	Years of using games	IT skill level
Participant 1	18	6–12	No	None	Not experienced
Participant 2	15	16–19 9–12	Yes	1 year	Highly experienced
Participant 3	25	7–9	Yes	10 years	Some experience
Participant 4	14	9–12 16–19	Yes	3 years	Highly experienced
Participant 5	25	9– 19	Yes	None	Not experienced
Participant 6	Over 1 year	10–14	Yes	1 year	Highly experienced

5.4.4 Thematic analysis discussion

This section discusses the thematic analysis approach used for the think aloud interviews to highlight the practical aspects of the gamification elements. Use of the exploratory approach, which is referred to as content-driven by Guest *et al*. (2012), means that the codes are not predetermined and the researcher needs to develop the themes inductively based on the available data set (Boyatzis, 1998), as explained in Chapter 1, Section 1.6.4. Furthermore, the aim of this stage (Stage 2) was to validate the practicality of the gamification elements from the teachers' perspective. Thematic analysis was used to highlight unforeseen aspects from the data set, as advised by Braun and Clarke (2006). The discussion of thematic analysis as a research tool is provided in Chapter 1, Section 1.6.4.

The think aloud interviews data set yields six themes, listed below and illustrated in Figure 5-7:

1. Individual gamification elements;
2. Teachers' conceptualisation of gamification and its elements;
3. Teachers' experience effect on utilising gamification elements;
4. The relationship between the aim of the game and the number of used elements;
5. Possible design routes; and
6. Increased appreciation for game developers' expertise.

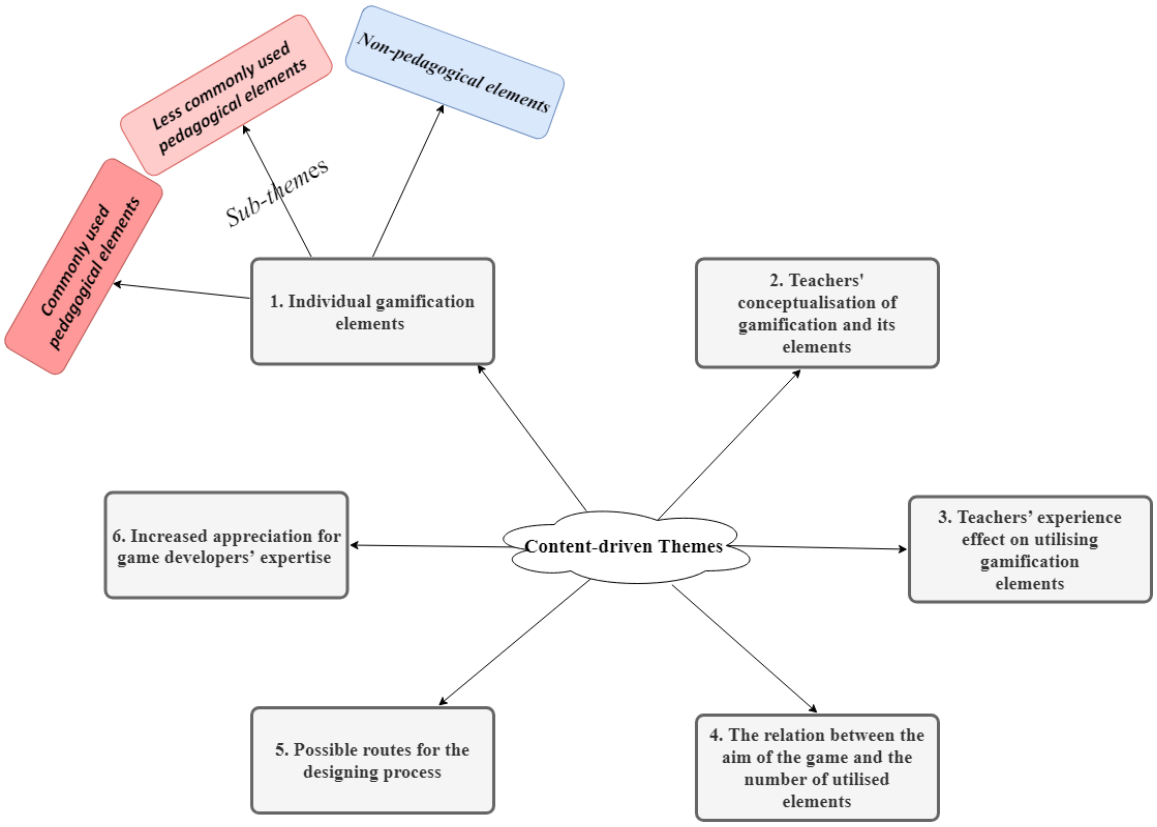


Figure 5-7. Themes of the Analysis

Theme 1: Individual gamification elements

The gamification elements were examined at three points, which are referred to as 'codes' in the thematic analysis process, as illustrated in Figure 5-8. Code 1, in-theory categorisation, is defined at an early point in the interview when participants identified the gamification elements as teacher-driven, game developer-driven or shared tasks. The Code-1 categorisation options are consistent with categorisation options provided in the survey, as discussed in Chapter 4, Section 4.6. Code 2 is associated with the participants' practical utilisation of the gamification elements through the task design (sketch). Code 2 revealed the presence of three levels: confidently utilised, needed guidance,

and not utilised, which were assigned by the researcher and not by the participants. Foremost, 'confidently utilised' pertained to instances in which the teacher had an in-depth grasp of applying the element, including presenting an illustrative example. Secondly, 'needed guidance' pertained to when participants had a strong understanding of the game elements but lacked the practicality of applying them in the task design. Lastly, 'not utilised' is where elements were not referred to in the task design. Code 3 involves the teachers' conceptualisation of the elements during the interview.

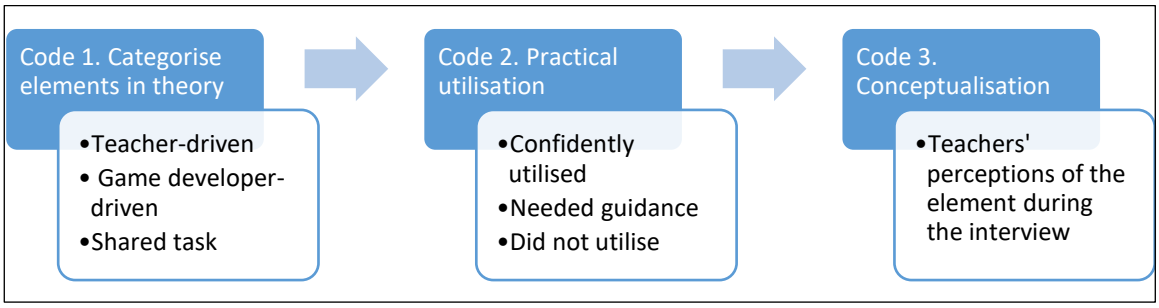


Figure 5-8. The Individual Gamification Elements Theme-Coding Process

All three codes led to different perceptions of the gamification elements' levels of pedagogy. In this context, pedagogy refers to a characteristic associated with the learning process and the element to be planned by the teachers rather than the game developers. The comparison between Codes 1 and 2, stating the number of participants in each category, is outlined in Table 5-4. An extended version of this table including the participant numbers can be found in Appendix E.3.

Table 5-4. Gamification Elements in the Theoretical Categorisation and Practical Utilisation

Gamification elements	**In-theory** categorisation (Code 1): Relates to number of participants			**In-practice** utilisation during task design (Code 2): Relates to number of participants		
	Teacher-driven task	**Game developer's task**	**Shared task**	**Confidently utilised**	**Needed guidance**	**Not utilised**
1. Goals	5	0	1	5	1	--
2. Level	4	1	1	4	1	1
3. Multimedia choices	4	1	1	3	3	--
4. Timing	3	0	3	5	1	--
5. Social engagement	3	0	3	4	1	1
6. Number of players	3	0	3	4	1	1
7. Reward structure	5	1	0	2	--	4
8. Replay option	4	0	2	2	1	3
9. Controls	3	1	2	1	5	--
10. Storyline	4	0	2	1	2	3
11. Added excitement	3	2	1	1	--	5
12. Rules	2	3	1	1	2	3
13. Learning progression presentation	3	2	1	--		6

The individual gamification elements analysis yielded three categories, called sub-themes, as illustrated in Figure 5-7. Firstly, 'commonly used pedagogical elements of gamification', illustrated in red, includes elements 1–6. Secondly, 'less commonly used pedagogical elements of gamification', illustrated in light red, includes elements 7–9. Lastly, 'non-pedagogical gamification elements', in blue, are elements 10–13. The categorisation of all 13 elements is shown in Figure 5-9. The discussion of individual elements follows the three codes, in order, and a summary. The following section offers a full discussion of a goal as a gamification element and as an example to demonstrate the approach. Only the summary of the changes or additions to the AH-GPD

framework is provided for the remaining 12 elements; the full analysis of these elements can be found in Appendix E.4. The colour coding of the individual elements is as follows: coloured background text highlights the justification of the elements' categorisation; italicised text in blue and green highlights the addition of the 'sub-elements' to the AH-GPD framework.

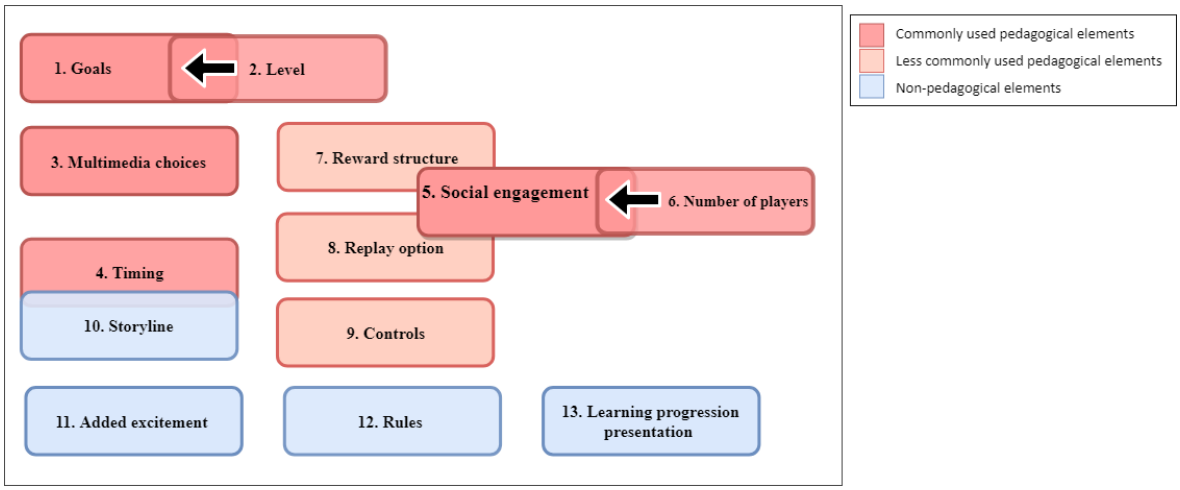


Figure 5-9. Individual Gamification Elements Categories

Sub-theme 1: Commonly used pedagogical elements of gamification

The first sub-theme is the commonly used pedagogical elements of gamification that, through teachers' discussions, seemed highly related to learning and require teachers' input as well as at least five participants regardless of the level of utilisation. There are six commonly used pedagogical elements of gamification: Goals, Levels, Timing, Social engagement, Number of players and Multimedia choices; all are highlighted in the red rows on Table 5-4.

Element 1. Goals

The goals set as a gamification element is discussed in detail in Chapter 3, Section 3.5. Kapp (2012) distinguishes a game from a play by a goal; a game is defined by the goals that provide a milestone to reach. According to García *et al*. (2017), the perception of goals is a measurable outcome of the game. Özdener (2017) referred to the goals as 'challenges', meaning tasks to be accomplished by students. In this research, goals represent pedagogical objectives that are transformed into milestones to be reached. The significance of players accomplishing the milestones is to promote motivation (Landers et al., 2017).

Code 1: In the initial categorisation part of the interview, *five participants perceived goals as a teacher-driven task*, and only *one participant* chose to keep the element as *a shared task*. The in-theory categorisation reflects the importance of goals from a pedagogical perspective.

Code 2: During the task design, *five teachers were able to apply the element confidently,* as illustrated in Table 5-3. P2, P3 and P4 wrote the goals as bullet points next to the interface sketch, while P1 narrated them to the researcher. P5 and P6 used writing at the beginning and for narrating

more goals later during the design. As the teachers worked through the sketch, sometimes they found a new goal(s) to be added, which suggests that identifying goals as an element has an iterative nature. *Codes 1 and 2 show consistency in demonstrating the goals pedagogical relatedness*. All participants were able to identify game goals. Five participants utilised the element confidently, displaying a significant level of understanding, while one participant needed guidance. The confident utilisation was identifying the lesson's learning objectives. The following comparison between a confident utilisation by P2 and a need for guidance by P6 is provided for illustration.

P2 showed confident utilisation, while P6 showed an understanding of high-level goals but needed guidance applying the element. P2's utilisation confidence was demonstrated in identifying goals for the following example English-language lesson: P2 highlighted the students' ability to identify the 'letter's sound, the letter's writing technique, recognising the letter in few words' as measurable goals related to the milestones of the game. In contrast, P6's utilisation involved identifying four goals; for example, P6 stated that it is necessary 'to provide the educational content for the student by dividing the scientific material into small chunks, so they acquire information easily'. In this participant's case, the goals were generic and unmeasurable. The first utilisation, by P2, was in accordance with the goals defined by (Kapp, 2012), (García et al., 2017) and (Landers et al., 2017), suggesting clear, measurable outcomes. Conversely, P6's utilisation showed an understanding of the generic concept of goals, where P6 explained that goals are 'small chunks' necessary to set requirements and measure the expected outcomes of the game. However, P6 did not identify any goals, which clearly demonstrated the need for guidance to identify the lesson's learning objectives as game goals. P6's perception was in line with García et al. (2017), who recognised goals as a measurable outcome of the game. Therefore, the framework should illustrate the standard two-fold mechanism in identifying goals—milestones and suggestions of measurement.

Code 3: Interestingly, *setting goals is one of the most utilised elements* in task design and is connected to levels as consequence elements in the design. This was discussed by P4, who stated, *'Defining the learning goal and ordering objectives from the easiest to the most difficult is part of the teacher's lesson plan'* during the initial in-theory categorisation. P4's comment suggests *a similarity between identifying the lesson's learning objectives and identifying game goals, which is supported by other participants.* For example, P1 stated, 'as it is a learning game, the goals will be lesson-learning objectives'.

In summary, the confidence and consistency in setting a goal(s) as a gamification element, in-theory and in-practice, foremost emphasises a high pedagogical relation of goals, which suggests that goals should be identified by teachers, or at least with teachers' input. This finding is in line with Lameras

and Moumoutzis's (2015) work, which emphasises the importance of having a teacher's input in goal setting.

Participants' utilisation suggests a dynamic nature of the element, requiring flexibility. Most of the participants started the task design by identifying goals. However, some participants wanted to add additional goals during the development process. This suggests *that identifying goals may be an iterative process, and the framework should enable teachers to add new goals at different points in the design process*.

To ensure the consistency of the framework, outcomes guidance was provided to participants to help them identify the goals. The findings highlighted a *two-fold mechanism in identifying goals—milestones and suggestion of measurement*. Furthermore, the goal-stating format as suggesting milestones and adding suggestions for measuring mechanisms involved, for example, offering a *suggestion list of quantifiable methods to measure them, hence, providing guidance with minimal technicality involved.*

Although the literature has suggested a relationship between Goals and Rewards—such as badges (Browne et al., 2014; Botha & Herselman, 2015) or points (González et al., 2016)—the relationship was not recognised by the participants in this study.

Element 2. Levels

The persistent utilisation of *defining levels by the participants, in-theory and in-practice, emphasises the importance of defining levels from a pedagogical perspective*. Moreover, the level-defining task is highly relevant for teachers. Participants' utilisation during the task design manifested as a relation and sequence between Goal and Levels. The goals were addressed first and were broken down into small learning objectives that ascended with the challenge level. Therefore, the framework *merged levels within goals and allowed the facilitation of the ascending nature of the learning objectives.*

Element 3. The multimedia choice

The literature review clearly indicates the importance of multimedia in gamification design. *All participants utilised this element, which suggests a good level of understanding*. Nonetheless, there is a need to provide *a supporting list for multimedia*, which was evident in P1, P4 and P5's utilisation. The three participants' options were limited and did not reflect the nature of a game. The different multimedia options could include videos, animation, music and audio, which are all components of a computer-based learning system (Mayer, 2017).

Element 4. Timing

Both initial categorisation and task-design utilisation illustrated the importance of timing as a gamification element and their high correlation with teachers' pedagogical knowledge. They also

indicated a relationship between learning-task duration and students' individual abilities. This suggestion was identified at different stages of the process and was made by two participants, P3 and P1. P3's suggestion was to create a function to allow teachers to set different timing requirements for each group based on their abilities. During in-practice utilisation, P1 predicted that time spent accomplishing a task would increase according to difficulty. Based on the foregoing discussion, a flexible mechanism implementation is required to customise the task's duration according to different students' paces. Along similar lines, Faghihi et al. (2014) discussed individual players' learning speed differences and implemented the game in a way that specified the task's duration according to each individual's pace. *The sub-elements of timing were three task durations: below average, average and above average*.

Element 5. Social engagement

Five participants provided a social engagement plan, which illustrates a high relationship to pedagogy. The teachers' discussions reflected a good level of interest in this element and related the social plan with team scores and the leader board. The discussion illustrated *a relationship with rewards*; the Reward structure is discussed further in Element 7. Another suggested *relationship is with the Replay option*; this detail is discussed further in Element 8. One participant's utilisation *illustrates the need to add the individual plan as a sub-factor of Social engagement alongside cooperation, collaboration and competition, which is a valid design decision*.

Element 6. Number of players

Initial categorisation and task-design utilisation both illustrated the importance of number of players as a gamification element and the high relatedness with teachers' pedagogical knowledge. Moreover, due to the similarity between the number of players and the social engagement plan described in the participants' discussion, *the Number of players merged as a sub-factor of the Social engagement plan*(Element 5).

Sub-theme 2: Less commonly used pedagogical elements of gamification

This sub-theme encompasses elements that, through the teachers' discussion, seemed highly related to learning and required consideration of teachers' input. However, on the practical side, the elements were utilised by a smaller number of participants. The less commonly used pedagogical elements of gamification are: Reward structure, Controls and the Replay option, as highlighted in light red in Table 5-4.

Element 7. Reward structure

Regardless of the high pedagogical relatedness of rewards, which was suggested in-theory (Code 1), only two participants utilised them. Both P3 and P6 *related successful completion with points, which limited the alternative reward options*. One participant misapplied the rewards concept, using some type of rewards in class (i.e. sweets from the jar and achievement certificates). Applying

a non-electronic form does not transform the rewards concept to the computer-game experience. Therefore, *the reward in electronic form needs to be reinforced by providing examples of electronic forms, such as points and badges*. There is a need to ensure that *other students' points will not be visible to avoid demotivating individuals, as advised by P1*.

The utilisation of P3 and P6 *emphasised a relationship between Rewards and Social engagement.* Another suggested relationship amongst *the gamification elements is between Rewards and the Added excitement curve (i.e. bonus points)*; added excitement is discussed further in Element 11.

Element 8. Replay option

The Replay option in-theory categorisation varied between teacher-driven and shared tasks. Nonetheless, *all participants agreed that, from a pedagogical perspective, the game should always keep the replay option feasible*. However, *this was less strongly emulated in the task design, as three out of six teachers did not utilise the replay element*. Moreover, the participants agreed that, at the very least, *students should not restart the game from the beginning, but should complete it from the last successful stage. This was in line with P4's concern of leading to boredom, which suggests that only a limited number of attempts should be offered before moving to the next part of the game*. The evolved decision by P3 illustrates that the task design sketch provided an in-depth context for the element's applicability; therefore, it informs teachers' context and choices. P3's utilisation *suggested a relationship between the Replay option and Social engagement, where the competition dictates no replay option*. Another suggested connection, offered by the same participants, was *between the Replay option and Rewards (i.e. when a replay occurs, no points will be added).*

Element 9. Controls

All participants chose controls despite the initial variation categorisation given, which illustrated high pedagogical relatedness. Nonetheless, five participants' utilisation showed a need for guidance. Specifically, it is necessary to provide *a supporting list for controls*, which was evident in the utilisations of P1, P2 and P5.

Sub-theme 3: Non-pedagogical elements of gamification

Lastly, the non-pedagogical gamification elements sub-theme identifies that the participants' discussions suggested no significance in pedagogical perspective and relating the elements to the game experience. Furthermore, on the practical side, the non-pedagogical elements were not utilised by half (or more) of the participants. The four non-pedagogical gamification elements are: Storyline, Added excitement, Rules and Learning progression presentation, as highlighted in blue in Table 5-4.

Element 10. Storyline

The participants' utilisation of a storyline as a gamification element identified different levels of applicability. *Three participants applied a storyline. Only one participant utilised it confidently, while two needed guidance.* The storyline has two sub-factors to improve teachers' utilisation and provide guidance: *game span and expected game duration*. Firstly, *game span illustrates the number of session(s) of a certain game*. For example, is it a one-time in-class practise or a series of exercises to be played throughout a semester? Secondly, *the expected game duration* is the time spent on the game, which represents the relationship between Storyline and Timing as two gamification elements. For example, does the game involve a few simple tasks that take less than 10 minutes, does it take longer? Knowing this can help the game developer to think of the time needed to narrate a storyline or the tools that can be used to build a context. Both sub-factors' significance is to guide teachers to the *relevant storyline standard, which was concluded from the foregoing discussion:*

- *A comprehensive storyline* for a game that is expected to last longer and be used by students on a regular basis was applied by P3. Such a game used in a course throughout a semester could have a cohesive story with a character. To follow the storyline, aspects suggested by Kapp (2012) include characters, plot, tension and resolution.
- *A facile storyline* that builds some interest and engages students, such as the representation of a familiar character for simple tasks, was applied by P1 and P5. For example, a game used for a lesson review may not need a full story.
- *No storyline* was applied to individual tasks by P2, P4 and P6.

Element 11. Add excitement at certain points

The Added excitement in an educational game is a critical requirement to engage students. *Discussion with some participants about the added excitement showed an appreciation of the game developers' experience*, which is in line with *Kapp (2012) who referred to the curve of excitement as a game-designer's task*, as discussed in Chapter 3, Section 3.5. Furthermore, participants demonstrated a self-conscious attitude towards their skills' limit. *This element was used by only one teacher, which emphasises the non-pedagogical nature of the element*. *Therefore, the added excitement as a gamification element should be moved with the HCI elements to the category of game developers' tasks*. The limited grasp of the element suggests a need for a *supporting list of excitement mechanisms* as a sub-factor alongside *the suggested time* to provoke these mechanisms.

Element 12. Rules

The *participants demonstrated an appreciation of the game developer's expertise in devising rules* more than any other elements in this research. *Three (3) participants assign the task to game*

developers. This was clear in the categorisation as three participants designated the element for a game developer. Moreover, half the participants did not utilise the rules in-practice. Furthermore, there is no suggested relation between Rules and any other gamification elements. Therefore, the Rules as gamification elements should be moved with HCI elements as game developers' task.

Element 13. Learning progression presentation

Discussions with the participants illustrated that providing performance feedback is crucial and could motivate players. Through initial categorisation, it was anticipated that this element is a key focus for teachers, which is in line with (Naik & Kamat, 2015; Chou, 2016; Steinberger et al., 2017). However, this was not supported by the task design practice. *Lack of utilisation in practice did not reflect the level of importance.* This might be due to participants' fatigue during the interview, as this element was discussed at the end of the provided gamification elements list. The framework should include *a supporting list of presentation examples*, as P2 suggested.

The outcomes of Theme 1 are as follows:

- The names used to express the elements were shortened to match teachers' use.
- The number of elements investigated decreased from 13 to 11. Two elements, Level and Number of players, were merged as sub-elements of Goals and Social engagement plans, respectively, as illustrated in Figure 5-10.
- Another two elements, Rules and Added excitement, were determined to be related to game developers rather than teachers. The participants demonstrated a high appreciation of the game developers' expertise, which is also discussed in Theme 6. Therefore, rules and added excitement were moved to the end of the list of 'non-pedagogical' elements.
- Rules and added excitement are highlighted in green boxes in Figure 5-10. Appendix E.5 includes the details of the changes that occurred to the order of the element.
- The participants' utilisation suggested that sub-elements represent a new layer of the framework; these are outlined in Figure 5-11.

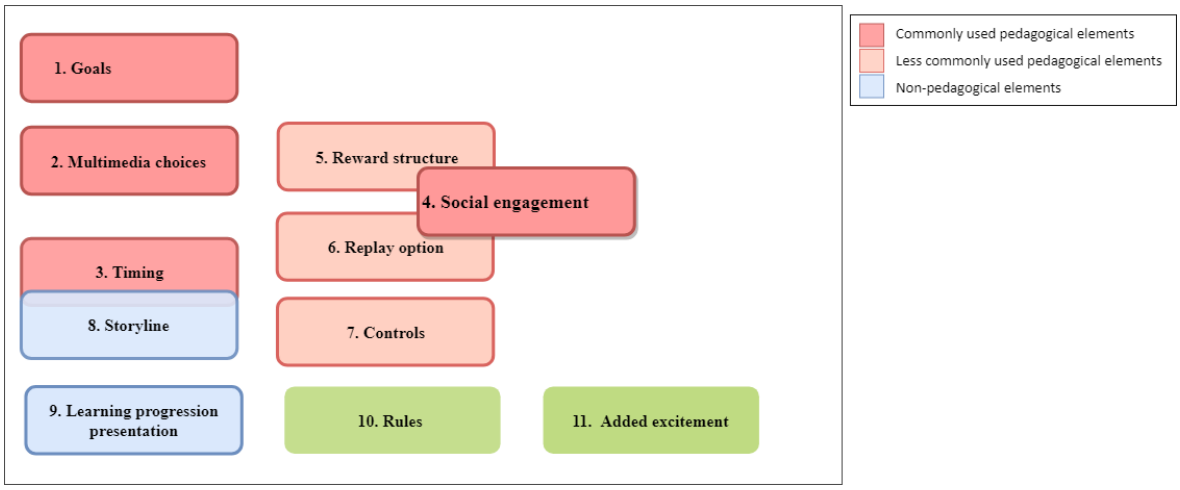


Figure 5-10. The Gamification Elements According to the Theme-1 Findings

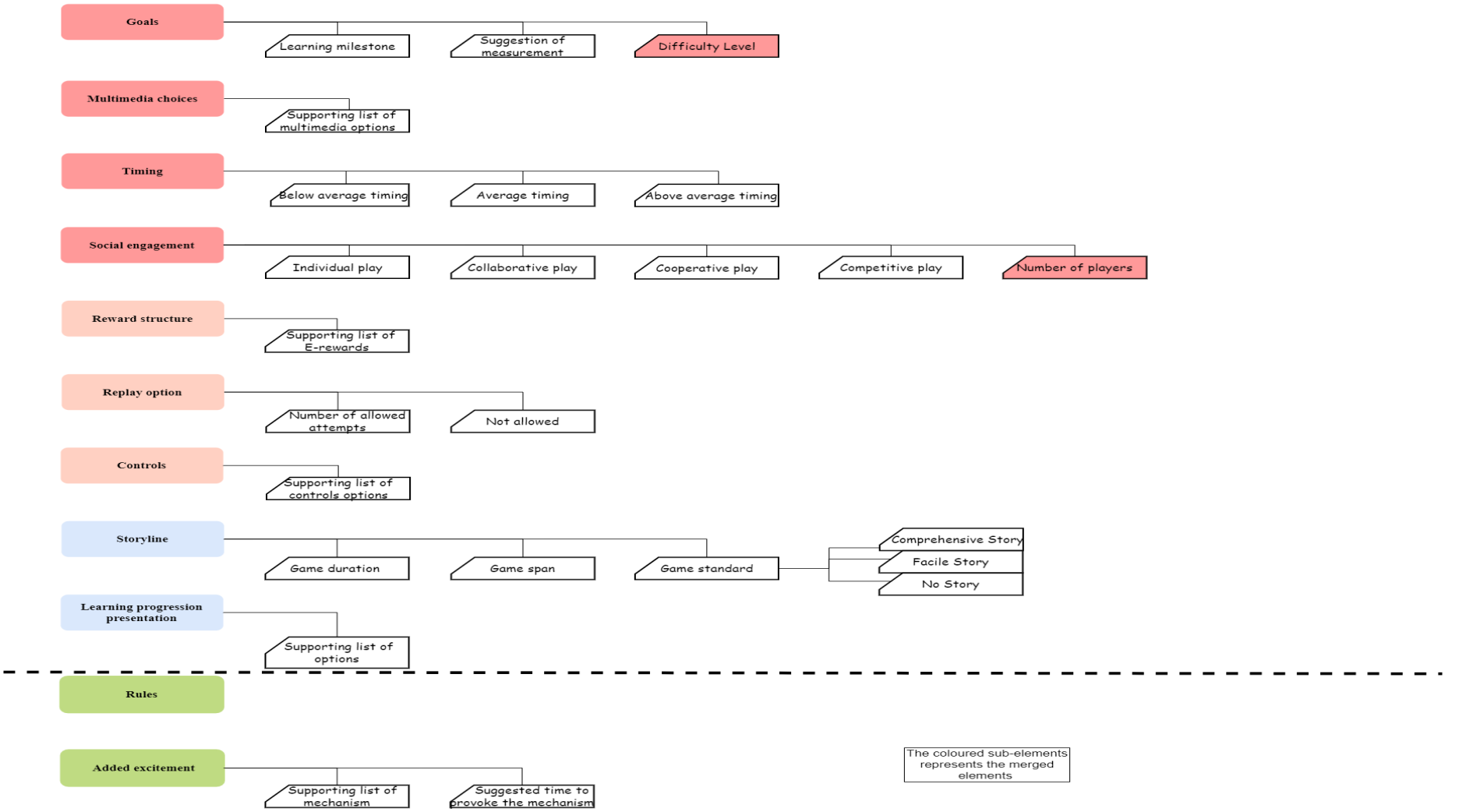


Figure 5-11. The Sub-Elements Represent a New Layer of the Framework

Theme 2: Teachers' conceptualisation of gamification and its elements

The investigation showed that participants, in general, have a high-level grasp of gamification concepts at a theoretical level and are already using some forms of non-electronic gamification schemes as extrinsic motivation. This includes, for example, using a reward structure, leader board and social planning cooperation amongst students in the class. During the discussion, all the teachers in the interviews acknowledged gamification as a powerful tool to keep students engaged in class. For instance, P4 acknowledged the positive effect of electronic games and stated, 'electronic games at the beginning of the class excite students and promote energy, so that is why I mostly choose it as an introduction to the topic. However, I do use it to recap at the end as well'. However, there is a need for guidance to facilitate practical utilisation, which is provided in the sub-elements in Figure 5-11.

Furthermore, three elements were misapplied: Rewards, Social engagement and Rules. The Reward concept was misapplied by P4 using a non-electronic form (i.e. a treat from the box). P4's utilisation did not transform the Reward concept to the computer-game experience. Another misinterpreted element was Social engagement. P2 suggested an email as a communication tool between teachers and students instead of planning cooperation or competition amongst students. Lastly, Rules were misapplied as a gamification element by two participants, P3 and P6. One participant applied navigation controllers as a rule (i.e., when to move to the next screen); using the correct answer as the only navigation controller might cause frustration for students. Another participant misapplied the concept of rules by utilising them as in-class disciplinary actions, such as using the games as a reward and punishment mechanism. Neither of the participants' utilisation of Rules as a gamification element conveyed the concept of the game adopted in this research, as identified in Chapter 3, Section 3.5. The misapplication of rules supports the decision of categorising them as a game developer's task. The need to provide an explanation for the elements to enhance teachers' perceptions of gamification elements is in line with (Melero et al., 2013).

Theme 3: The effect of teachers' experience on utilising gamification elements

This theme investigated the relationship between teachers' experience, in both IT and teaching, and the number of utilised gamification elements in-practice (i.e., the task design part of the interviews). Teaching experience in years, IT skill level, and the number of elements utilised by participants are illustrated in Table 5-5. Every participant chose a varied number of gamification elements from the provided list, as outlined in Table 5-5.

Table 5-5. Number of Used Elements and Participants' Experiences

Participant	Years of teaching experience	Years of using games	Number of gamification elements used in task design
Participant 1	18	None	8
Participant 2	15	1 year	7
Participant 3	25	10 years	12
Participant 4	14	3 years	8
Participant 5	25	None	8
Participant 6	> 1	1 year	9
Average			8.6 ≈ 9
Standard deviation			1.7

The number of utilised gamification elements varied amongst participants, with an average of 9. Two participants, P3 and P5, had the same number of years of teaching experience, but the number of utilised elements differed. P3 utilised 12 elements while P5 utilised 8. Noticeably, P3's years of using IT exceeded P5's, with 10 years to none, as illustrated in Table 5-5. P3 had been using electronic games in class for a considerable amount of time; therefore, this respondent was more aware of the details needed to set a game specification. Conversely, P2 and P6 had used games in class for 1 year; however, P2's teaching experience exceeded P6's by roughly 14 years. Yet, their number of utilised elements was different: P2 used 7 whereas P6 used 9. Therefore, the relation between years of teaching experience and utilised elements was not clearly established.

Theme 4: The relation between the aim of the game and the number of utilised elements

During the task design, the teachers mentioned the aim of the game being designed. The options were varied, as follows:

- Introduction, used by P4; a simple activity, such as a puzzle, for the teacher to conclude the topic of the lesson.
- Explain the lesson, used by P6; replaces a teacher's role using videos, audio, images and animation to explain the lesson and adding gamified tasks in between. Involves elements such as using points and adding timing to the game.
- Explain part of a lesson, used by P2; the teacher explains part of the lesson and leaves some objectives to be illustrated through the game and designed activities to keep students following the lesson plan.

- Extra practice, used by P3 and P5; a recap of a lesson already explained in class by the teacher. The designed game aims to consolidate the learning objectives and measure students' understanding.
- Explain part of the lesson and practice, used by P1; provides a mix of the preceding two points.

Table 5-6 illustrates the aim of the game and highlights the number of elements used by each participant. The level of practical applicability by the participants is discussed in Theme 1.

Table 5-6. The Aim of the Game and the Number of Elements Utilised

Participant	**Aim of the game in sketch**	**Number of utilised elements**	**Confidently utilised**
P1	Explain part of the lesson and practice	8	3
P2	Explain part of the lesson	7	4
P3	Extra practice	12	10
P4	Introduction	8	5
P5	Extra practice	8	5
P6	Explain a lesson	9	6

Interestingly, two participants (P3, P5) designed the game for the same purpose of extra practice, which is highlighted in Table 5-6. However, they utilised a different number of elements. P3 utilised 12 gamification elements, of which 10 were applied confidently, whereas P5 utilised 8 elements, with 5 utilised confidently. Thus, there is no clear relationship between the aim of the game and the number of used elements. During the task design, use of the Replay option as a gamification element was influenced by the aim of the game as identified by the participants. For example, if the aim of the game was to explain part of the lesson, the students were allowed to replay the game until they were confident with the learning objectives. However, if the game aim was to evaluate students' acquisition, then the replay option was not provided.

Theme 5: Possible routes for the designing process

This theme investigated the participants' design routes through the practical task design (sketch) by identifying the sequence of utilised elements outlined in Table 5-7. The significance of utilising sequence is to highlight the highly pedagogical related elements and to identify the similarities of the design process amongst participants. The investigation yields two patterns: instinctive and successive utilisation. Foremost, five out of six participants defined the Goals of the game as a first step in the design, as illustrated in Table 5-7. Secondly, three participants followed identifying

Goal(s) by setting Levels (i.e. tasks flow from the easiest to the most challenging). The consistency in this design order indicates an instinctive utilisation where participants were confident applying both Goals and Levels without the researcher prompting them to consult the provided gamification elements list. Participants' instincts were informed from the resemblance to traditional lesson preparation, as discussed in Theme 1: Individual gamification elements, Element 1. However, most participants later consulted the gamification elements list to proceed to the next design decision, which led to another interesting connection.

The other pattern is the connection between planning Social engagement and the number of players involved in a game. Five out of six participants utilised one followed by the other as the next design decision.

The participants demonstrated an instinctive utilisation, readily identifying Goals and Level sequences. This supports the decision of including Levels as a sub-element of Goals, as discussed in Sub-theme 1**: Commonly used pedagogical elements of gamification**. Furthermore, the successive utilisation between Social engagement and the Number of players supports the decision of merging the Number of players as part of the Social engagement element, which was also discussed in Sub-theme 1**: Commonly used pedagogical elements of gamification**. However, the remaining elements utilisation suggests no other sequence or relation, as illustrated in Table 5-7.

Table 5-7. Participants' Sequence of Utilising the Gamification Elements

Gamification elements	P1	P2	P3	P4	P5	P6
1. Goals	1	1	1	6	1	1
2. Level	7	2	2	0	2	7
3. Multimedia Choices	3	3	4	2	6	8
4. Timing	6	6	5	3	8	3
5. Social engagement	4	0	11	5	3	5
6. Number of players	5	0	12	4	4	6
7. Reward structure	0	0	7	0	0	4
8. Replay option	0	5	9	8	0	0
9. Controls	8	4	6	7	7	9
10. Storyline	2	0	3	0	5	0
11. Added excitement	0	0	10	0	0	0
12. Rules	0	0	8	1	0	2
13. Learning progression presentation	0	0	0	0	0	0

Instinctive Utilisation

Successive Utilisation

Theme 6: Increased appreciation for game developers' expertise

During the discussion, teachers showed confidence in being the key person designing an educational game. However, the task design illustrated a need for a workflow of the process to enable teachers to participate fully. Participants agreed that the role of a game developer is critical in the implementation of the game, however, during the first design stages, teachers' knowledge of pedagogical requirements will be more important. Yet, teachers expect to cooperate with game developers.

The discussion with teachers demonstrated the need for game developers' expertise in two elements more than others: Rules and the Added excitement. Firstly, participants demonstrated an appreciation of the game developers' expertise in devising Rules more than any other element in this research. This was clear in the categorisation, as three participants designated the element for a game developer. Moreover, half the participants did not utilise the Rules in practice. On the other hand, two participants demonstrated a need for guidance by misapplying game rules as a concept, creating in-class behavioural rules. Secondly, as for the Added excitement, only P4 acknowledged the game developers' expertise, saying "the game developer should be familiar with this task, as he/she has been designing for a while and his/her experience exceeds mine" (P4). This choice demonstrates the teacher's awareness of the critical technicality of this task and their readiness to value and accept the game developers' input. Furthermore, only one participant was able to apply the element, while five participants did not, as illustrated in Table 5-4.

5.5 Discussion of the findings of the Interviews: Initial Pilot and Think Aloud

The findings from the think aloud interviews influenced modifications to the AH-GPD framework (Version 2); the changes are highlighted in Figure 5-12. These changes resulted in Version 3 of the AH-GPD framework. The process of change is explained, step-by-step, in Appendix E.6. Four gamification elements were added to the teachers' task division: Level, Social engagement, Controls and Replay option. Furthermore, Rules as a gamification element was added to the game developers' tasks. This change is illustrated with red arrows in Figure 5-12. Two gamification elements, Level and Number of players, were merged into others as sub-elements. Levels became a sub-element of Goals, and Number of players became a sub-element of the Social engagement. These changes are illustrated with black arrows in Figure 5-12. Therefore, the final number of elements in teachers' tasks is nine, circled in orange, and the game developers' tasks are five, circled in green, as illustrated in Figure 5-13.

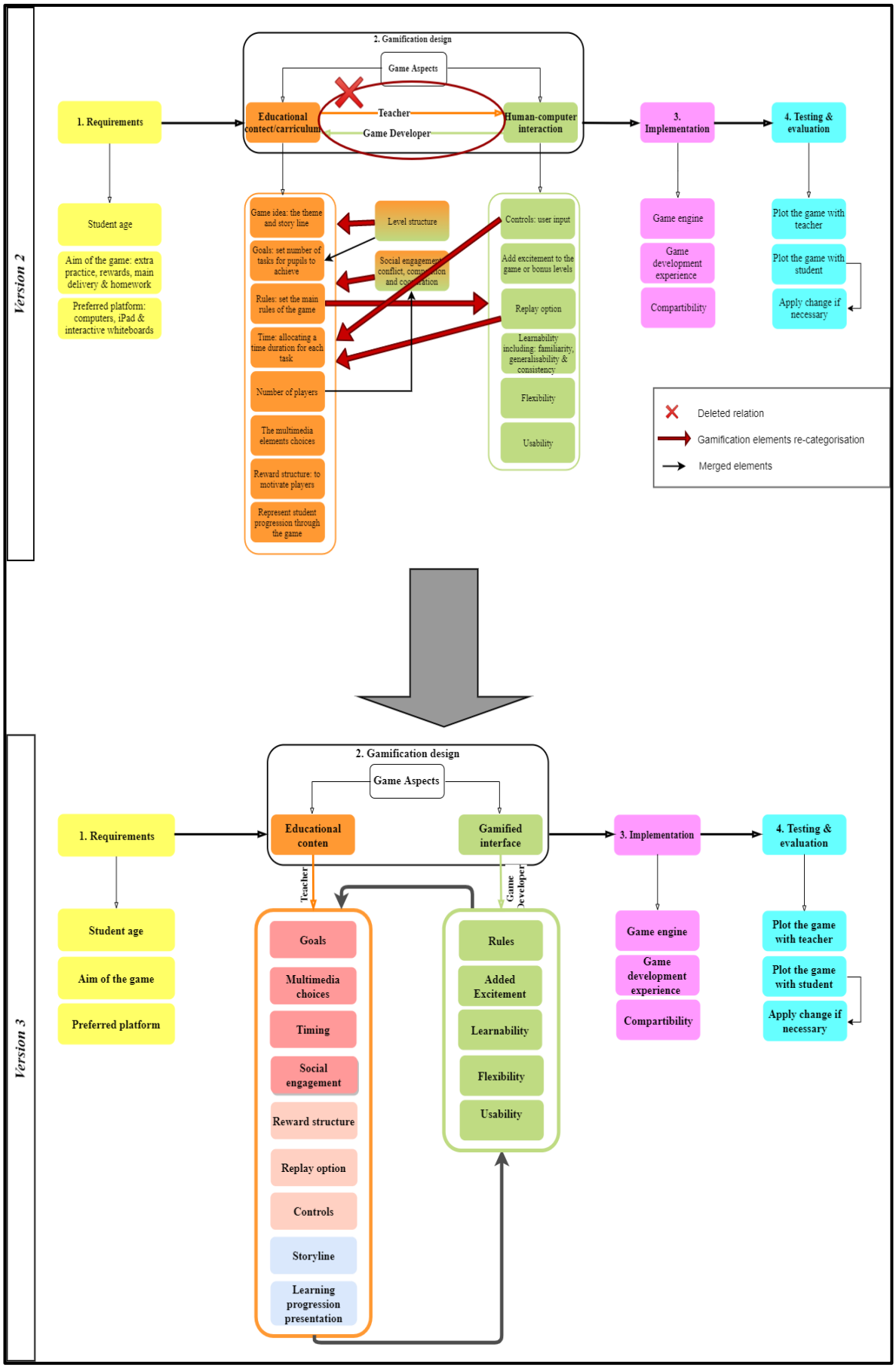


Figure 5-12. Highlight of the Changes in AH-GPD Version2 to Apply the Findings in Version 3

The findings suggest that the nine elements categorised as teachers' tasks have a new categorisation based on their pedagogical relatedness. The new categorisation includes: 'commonly used pedagogical elements of gamification', illustrated in red; 'less commonly used pedagogical elements of gamification', illustrated in light red; and 'non-pedagogical gamification elements', illustrated in blue, as shown in Figure 5-13. Although Figure 5-10 depicts the elements numbered in accordance with pedagogical relatedness, Version 3 omitted the numbers, as illustrated in Figure 5-13. This was due to the lack of consistency in design pattern, as explained in Theme 5.

The communication between teachers and game developers was moved from the high-level layer of the framework, illustrated in the red circle in Figure 5-12. The framework retains teachers as gatekeepers of a gamified learning design process by leaving them as the starting point for facilitating the gamification elements. The iteration/feedback loop has been placed between the grouped teachers' tasks and game developers' tasks, as illustrated in Figure 5-13.

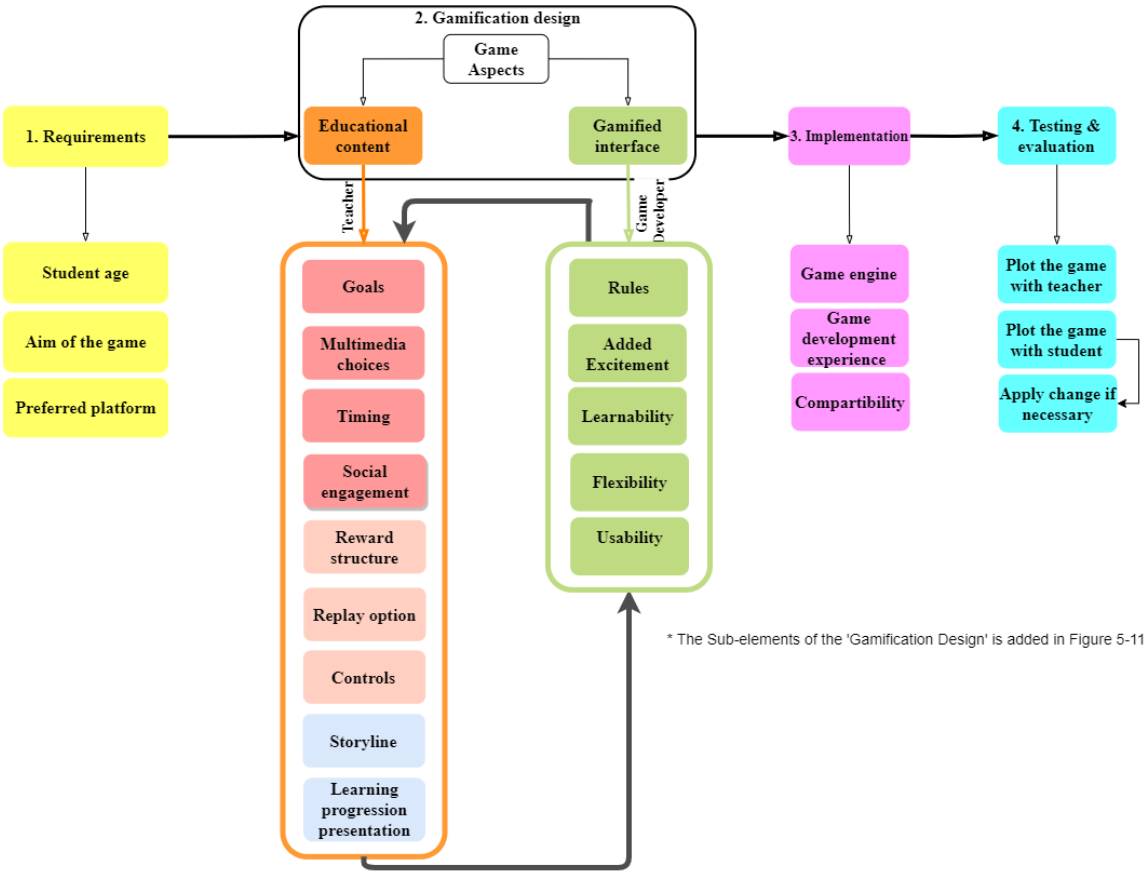


Figure 5-13. AH-GPD Framework (Version 3)

To improve the framework's adaptability for teachers so that it requires no technical knowledge, the gamification element names have been shortened. The shortened form is in accordance with teachers' reference to the elements during the interview, ensuring the conceptual clarity of the elements. Furthermore, the sub-elements provided in Figure 5-10 add to the adaptability of various levels of computer literacy by providing the necessary details.

Due to the addition of gamification elements to the game developers' tasks, it was necessary to change the name of the high-level 'Human–computer interaction' to 'gamified interface' to represent all the elements, as illustrated in Figure 5-13.

The practical utilisation confirms the teachers' need for guidance through the design requirements decisions to enhance the flexibility and adaptability of the framework. Therefore, another layer was added to the framework, resulting in a multi-layer framework including the sub-elements, as illustrated in Figure 5-11.

5.6 Conclusion

Chapter 4 presented the AH-GPD Framework (Version 2) as an outcome of the survey findings. The AH-GPD framework supported the classification of the gamification elements into teacher-driven, game developer-driven, or shared tasks. This chapter presented the practical validation of the framework and its gamification elements. It was divided into two stages, an initial pilot study discussed in Section 5.3 and the think aloud interview protocol discussed in Section 5.4. The initial pilot interview aimed at two goals. Firstly, it sought to highlight the proposed framework's (Version 2) strengths and weaknesses from the teachers' perspective. The initial pilot (Stage 1) findings indicated that participants struggled to validate the practicality of the framework and its gamification elements as the components by identifying the requirements on a high level.

Therefore, in Stage 2, a refined procedure, the 'think aloud' interview protocol, was utilised, with the added practicality of an educational game interface sketch called 'task design'. Furthermore, the focus moved from high-level framework validation to applying the gamification elements in practice. Following an inductive thematic analysis, teachers were keen to be involved in gamification and clear about games' educational benefits. The task design in the interview led to different levels of practical utilisation of the gamification elements. The themes suggested an order based on their pedagogical relatedness, where setting the game goal(s) was the starting point in the design process. Using teachers' input to update the framework reinforced the adaptability aspect, where teachers could utilise the framework without any technical knowledge. Nonetheless, there was no reoccurring pattern in the overall design process by the participants. This suggests an agile framework that includes elements and sub-elements in a customisable form where some or all elements can be used. This chapter outlined Version 3 of the AH-GPD framework, with a new layer that includes the sub-elements.

The findings yield an increased appreciation of game developers' expertise, but nonetheless emphasise their role in migrating to teachers' pedagogical knowledge. The next chapter validates the sub-elements featuring game developers as domain experts to strengthen the practicality of the framework, supporting its holistic approach.

Chapter 6. Game Developers' Validation of the AH-GPD Framework (Version 4)

6.1 Introduction

This chapter outlines the validation of the proposed framework with the game developers, the other collaborating domain experts, to support the teachers in the design of an educational game using the Agile Holistic Gamified Pedagogical Design (AH-GPD) framework. In the previous chapter, Version 3 of the AH-GPD framework was outlined based on the teachers' think aloud interviews, allowing the addition of sub-elements to support a flexible structure of the teachers' pedagogical input. Chapter 5's findings also yielded an increase in the appreciation of game developers' expertise, emphasising their role in migrating teachers' pedagogical knowledge into game design. The aim of this chapter is to confirm the game developers' elements, including both the HCI and the gamification aspects.

6.2 Context

This chapter discusses the process of integrating game developers' knowledge to enable collaboration with teachers. It also refines the framework and produces Version 4 by conducting interviews with game developers, as illustrated in Figure 6-1.

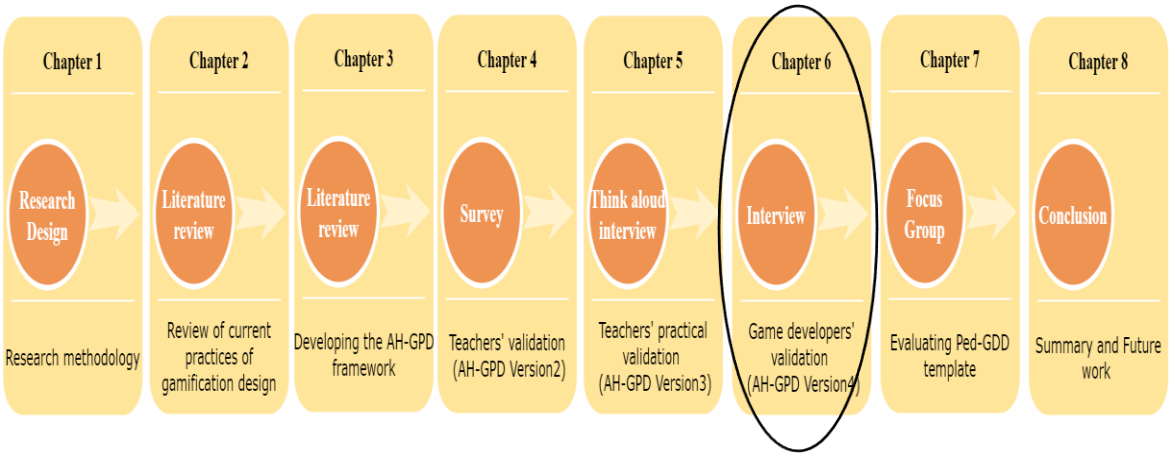


Figure 6-1. Chapter 6 in the Thesis Layout

This chapter has three parts, outlined in Figure 6-2. The first two concern the secondary research required. Firstly, there is a discussion of the Game Design Document. A search was conducted for game design requirements template(s) that have pedagogical input as structured requirements. The popular name for the template outlined in the literature is Game Design Document (GDD) (Salazar et al., 2012; Rogers, 2014; Stanley, 2014; Gonzalez, 2016; gamedesigning.org, 2018), which is discussed further in Section 6.3. Secondly, the sub-elements of the HCI provide a consistent structure with the gamification elements and are discussed in Section 6.4. Thirdly, the interviews with game developers were conducted to solicit their views and recommendations.

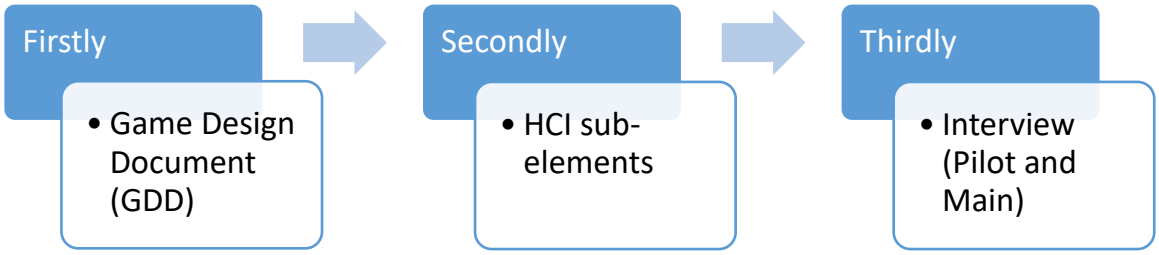


Figure 6-2. Chapter 6 Outline

The reason for considering game developers' perspectives at later stage in the framework development is that teachers are considered the gatekeepers in educational game, which is documented in Chapter 4, Section 4.2. Furthermore, research shows the importance of teachers' input and places them early in the design process. For instance, Mystakidis *et al*. (2014) designed a gamified e-learning environment where an interview with teachers was used during the design process to identify the learning objectives. Botha and Herselman (2015) describe teachers as 'content and context experts' in the process of designing a gamification course that supports their professional development. Schulz *et al*. (2015b) investigated teachers' motivation towards e-learning design and suggested that teachers should be more involved in the design process. Experimentation by González *et al.* (2016) to influence healthy lifestyles by playing active video games incorporated teachers as part of the design team. Markopoulos et al. (2016) discussed integrating e-learning and gamification and the benefits of teachers' input in organising the course. Bouzid *et al*. (2017) conducted an experiment to promote mathematics learning amongst primary pupils using ADDIE, as discussed in Chapter 3, Section 3.3 which utilised the first stage of the analysis with teachers to gather requirements and identify the significance of the experiment. Furthermore, the second stage, design, started with the pedagogical preparation of the content (Bouzid et al., 2017). As including the pedagogical aspect in gamification is the contribution of this research, the teachers' perception was considered in the earlier stages of the framework design. Additionally, the framework went through a number of revisions and the initial framework (Version 1) related only three elements to the game developers, as discussed in Chapter 3, Section 3.4.2 and Figure 3-11. As the research progressed, this number increased to five elements in Version 3, as discussed in Chapter 5, Section 5.5 and Figure 5-13, which now indicates the importance of the designers' input.

6.3 Game Design Document (GDD) Overview

In Chapter 5, the framework developed a new layer that includes the sub-elements structuring the teachers' pedagogical input (see Figure 5-11). There was a need to search for a game design requirements template(s) that communicates the pedagogical input as structured requirements to the game developers. The popular name for the template found in the literature is Game Design

Document (GDD) (Salazar et al., 2012; Rogers, 2014; Stanley, 2014; Gonzalez, 2016; gamedesigning.org, 2018). Although other design tools/frameworks were discussed in Chapter 2, Section 2.8 to review gamification design methods, in this chapter, GDD represents the current template used in the game development industry. One of the challenges of the current GDD to teachers is the use of technical terms (e.g., mechanics, gameplay, dynamics); without further description, teachers might be intimidated by technological attributes, as discussed in Chapter 5, Sections 5.3.3. Furthermore, Gonzalez (2016) used a commercial vendor's product that included business aspects, such as marketing.

There are similar elements included in the AH-GPD framework components and in current GDDs from the literature, with some differences in wording while retaining the meaning; for example, goals in this Ped-GDD were referred to as objectives by (Salazar et al., 2012), as milestones by (Stanley, 2014), and as challenges by (Gonzalez, 2016), as illustrated in Table 6-1. Another example is social engagement in Ped-GDD, which is referred to as enemies by (Salazar et al., 2012) and (Rogers, 2014), and as team size by (Stanley, 2014), as illustrated in Table 6-1. The AH-GPD framework has 11 elements that are mapped to the existing GDD and the equivalent range from 1 to 7, as illustrated in Table 6-1. Therefore, there is a need to develop a Pedagogical Game Design Document (Ped-GDD) template that facilitates collaboration between teachers and game developers by including pedagogical gamified requirements. Furthermore, the Ped-GDD is adaptable to accommodate different levels of teachers' computer literacy by providing examples.

Table 6-1. Mapping Ped-GDD Elements to the Existing GDD

Ped-GDD Elements	**GDD from the Literature Review**				
Gamification elements Framework components	GDD (Salazar et al., 2012)	GDD ten-pager (Rogers, 2014)	GDD template (Stanley, 2014)	GDD (Gonzalez, 2016)	GDD (gamedesigning.org, 2018)
Goals	Objectives, levels, challenges		Milestone	Goals, progression and challenges	
Multimedia choice	Aesthetic what players will hear and see		2D, 3D, sound, animation	Music and sound, art style	
Timing			Time scale		
Social engagement	Enemy	Enemies, multiplayer	Team size		
Reward structure	Rewards	Collectibles, monetization		Losing (i.e. score mechanics)	
Replay option					
Controls				User skills	
Storyline	Player avatar	Story	Theme, story	Characters, story, theme, story progression	Core concept
Learning progression representation		Progression		Progression and challenges	
Rules	Rules of how elements can interact with others	A mechanic is an item or element that **players interact with to create** or aid with gameplay			
Added excitement		Power-ups, bonus material		Items and powerups	
Number of matching	6/11	6/11	5/11	7/11	1/11

6.4 HCI Sub-Elements Gathering

To build the Ped-GDD components, the HCI sub-elements need to be identified from a literature review. The framework has three HCI elements—Learnability, Flexibility and Usability—and providing their sub-elements will retain the consistency of the Ped-GDD layout and fulfil its purpose.

6.4.1 Learnability

Dix *et a*l. (2004) define Learnability as "the features of the interactive system that allow novice users to understand how to use it initially and then how to attain a maximal level of performance" (Dix et al., 2004, p. 261). In this research context, Learnability is defined as the game's interface being easy to follow, and the interaction with the students requires no help. To collect the sub-elements, a list was compiled from references that represent different backgrounds in IT (i.e. software engineering, interface design and software product quality), as shown in Table 6-2. The purpose is to identify the shared sub-elements amongst the IT domains, which are highlighted in green in Table 6-2.

Table 6-2. Compiling the Sub-Elements of Learnability

Compiling the Sub-Elements of Learnability			
Software engineering	Software engineering	Interface design	System and software product quality
(Nielsen, 1993)	(Dix et al., 2004)	(Lazar et al., 2010)	(British Standard Institution, 2016) BS ISO-IEC 25023
P 29 summarised the measures to be included: 1. Initial ease of learning 2. Users' task completion	1. Predictability 2. Synthesizability 3. Familiarity 4. Generalizability 5. Consistency	How quickly and easily an individual can learn to use a new application or complete a new task and how long they retain the learned skill	1. User guidance completeness 2. Entry fields defaults 3. Error messages understandability 4. Self-explanatory user interface

The initial Learnability list included seven sub-elements, as illustrated in Table 6-3. Then, the list was refined to include game design-related sub-elements, and similarities were omitted.

Table 6-3. Initial Learnability Sub-Elements

Sub-element	Inclusion decision
1. Predictability	✓
~~2. Synthesizability~~	Related to system operation rather than interface design guidelines
3. Familiarity	✓
~~4. Generalizability~~	According to Dix et al. (2004), 'Generalizability can be seen as a form of consistency'
5. Consistency	✓
~~6. Task completion~~	Represents a measurement to assess the interface's learnability rather than interface design guidelines
~~7. Error messages understandability~~	Crossed from learnability and kept in usability

Finally, the refined list of Learnability includes three sub-elements: predictability, familiarity and consistency, which are defined in Table 6-4.

Table 6-4. The Learnability Sub-Elements

Sub-Element	Definition Adapted from (Dix et al., 2004)
Predictability	Support for the user to determine the effect of future actions based on past interaction history
Familiarity	The extent to which the user's knowledge and experience in other real-world or computer-based domains can be applied when interacting with a new system
Consistency	Likeness in input–output behaviour arising from similar situations or similar task objectives

6.4.2 Flexibility

Dix et al. (2004) define Flexibility as 'the multiplicity of ways in which the end-user and the system exchange information' (Dix et al., 2004: 266). In this research context, this allows the students to pass their input to the game in different ways. The initial Flexibility list included six sub-elements, as illustrated in Table 6-5. Then, the list was refined to omit similarities.

Table 6-5. Compiling the Sub-Elements of Flexibility

System engineering	**Software engineering**
(Light, 2003)	(Dix et al., 2004)
The new usability will be flexibility; not systems geared up to do what the organisation does, but systems that resemble factories for constructing locally the system that meets evolving needs. Customisation will be in the hands of middle managers and end-users, challenging both groups to learn more about each other's requirements.	1. Dialog initiative 2. Multi-threading 3. Task migratability 4. Substitutivity 5. Customizability

Finally, the refined list of Flexibility includes 5 sub-elements: Dialogue initiative; Multi-threading; Task migratability; Substitutivity and Customisability, which are all defined in Table 6-6.

Table 6-6. The Flexibility Sub-Elements

Sub-Element	**Definition Adapted from (Dix et al., 2004)**
Dialogue initiative	The ability to provide an equal chance for the player and the game to initiate a task. For instance, the player can click to log on to the game, or the game could prompt immediate log on; both lead to the same result.
Multi-threading	The game's ability to execute more than one task at a time
Task migratability	For instance, the player is able to save their progress and sign out. However, the system could do the same task automatically.
Substitutivity	Allowing different yet equivalent input methods, for instance, using the number as a numeral or choosing the number from a list.
Customisability	Modifiability of the user interface by the player or the game system itself.

6.4.3 Usability

In this research context**,** Usability is the extent to which the game can be used by players to achieve specified goals with effectiveness, efficiency and satisfaction in a learning context (British Standard, 2019). According to Ibrahim and Jaafar (2009), Usability is an under-explored aspect in educational game design. The compiled list for Usability includes 25 sub-elements, as illustrated in Table 6-7.

Table 6-7. Compiling the Sub-Elements of Usability

Software engineering	Interface design	General user experience
(Nielsen, 1993) (Dix et al., 2004)	(Lazar et al., 2010, p. 270)	(Marsh, 2016, p.158)
(Nielsen, 1993, p. 20, 115) Usability heuristics 1. Simple and natural dialogue 2. Speak the users' language 3. Minimize user memory load 4. Consistency 5. Feedback 6. Clearly marked exits 7. Shortcuts 8. Good error messages 9. Prevent errors 10. Help and documentation (Dix et al., 2004, p.325) cited Nielson's 10 heuristics for heuristic evaluation through expert analysis 1. Visibility of system status 2. Match between system and real world 3. User control and freedom 4. Consistency and standards 5. Error prevention 6. Recognition rather than recall 7. Flexibility and efficiency of use 8. Aesthetic and minimalist design 9. Help users recognize, diagnose and recover from errors 10. Help and documentation	Usability measurement Task performance, time performance, user satisfaction 1. Strive for consistency 2. Cater to universal usability 3. Offer informative feedback 4. Design dialogs to yield closure 5. Prevent errors 6. Permit easy reversal of actions 7. Support internal locus of control 8. Reduce short-term memory load	Usability implies less cognitive load Cognitive load is the amount of processing power that is required to complete a task P 161 Concludes to four main design rules: 1. Simpler: fewer steps 2. Easier: more obvious options 3. Faster: less time to complete/repeat the process 4. Minimal: fewer functions

The list was refined to include options related to game design and to omit similarities. The initial Usability list included 13 sub-elements, as illustrated in Table 6-8.

Table 6-8. Initial Usability Sub-Elements

Sub-element	Inclusion decision
1. Simple and natural dialogue	✓
2. Speak the users' language	✓
3. Minimize user memory load	✓
~~4. Consistency~~	Duplicated from usability and kept in learnability
5. Offer informative feedback	✓
6. Clearly marked exits	✓
7. Shortcuts	✓
8. Good error messages	✓
~~9. Aesthetic and minimalist design~~	The framework offers 'multimedia choice' as an independent element
10. Prevent errors	✓
11. Help and documentation	✓
12. Permit easy reversal of actions	✓
13. Support internal locus of control	✓

Finally, the refined list for Usability included 11 sub-elements: simple and natural dialogue, speak the users' language, minimize user memory load, offer informative feedback, clearly marked exits, shortcuts, good error messages, prevent errors, permit easy reversal of actions, support internal locus of control, and help and documentation, all of which are defined in Table 6-9.

Table 6-9. The Usability Sub-Elements

Sub-element	Definition
Simple and natural dialogue	Simplified the flow of the game with fewer steps and obvious options
Speak the users' language	Match the player's level of literacy
Minimize user memory load	Use recognition rather than recall
Offer informative feedback	Display the player's status
Clearly marked exits	Allowing the student to exit the game at any point in the game
Shortcuts	Guarantee less time to complete/repeat the process
Good error messages	Stating what caused the error and how to fix it
Prevent errors	The form of information needed
Permit easy reversal of actions	Providing the 'undo' option or change stored input
Support internal locus of control	Keep the focus on certain part on the interface
Help and documentation	Provide access for FAQ and helping tips

6.5 Pilot Interview

6.5.1 Overview

The pilot interview was designed to review the chosen interview protocol. The research facilitates Castillo-Montoya's (2016) approach to validate the interview protocol, which includes four phases: Phase 1—Ensuring interview questions align with research questions; Phase 2—Constructing an inquiry-based conversation; Phase 3—Receiving feedback on interview protocols; and Phase 4—Piloting the interview protocol.

6.5.2 Discussion and findings

The pilot interview was conducted with two participants experienced in software development and game design. The participants' comments influenced some changes in the interview protocol, which are outlined as follows:

- Initially, the intention was to use a Likert scale to quantify the relationship of the sub-elements from a game designer's perspective. However, the literature survey indicated that those sub-elements are explicitly proposed; consequently, the Likert scale was not appropriate in this instance, and the survey questions were modified accordingly.

- Added space to the form to allow interviewees to suggest a change of label/wordings or to add further explanation to the sub-elements, if needed.
- Provide definitions of all the HCI sub-elements due to the interchangeable use of the HCI terms.

6.6 Interviews

6.6.1 Overview

The purpose of the interview was to validate the sub-elements of the game developers' elements of the framework, which are presented in Figure 6-3. The interview questions are referenced in Appendix F. The findings of the pilot interview influenced minor changes to the interview protocol, as discussed in Section 6.5.2

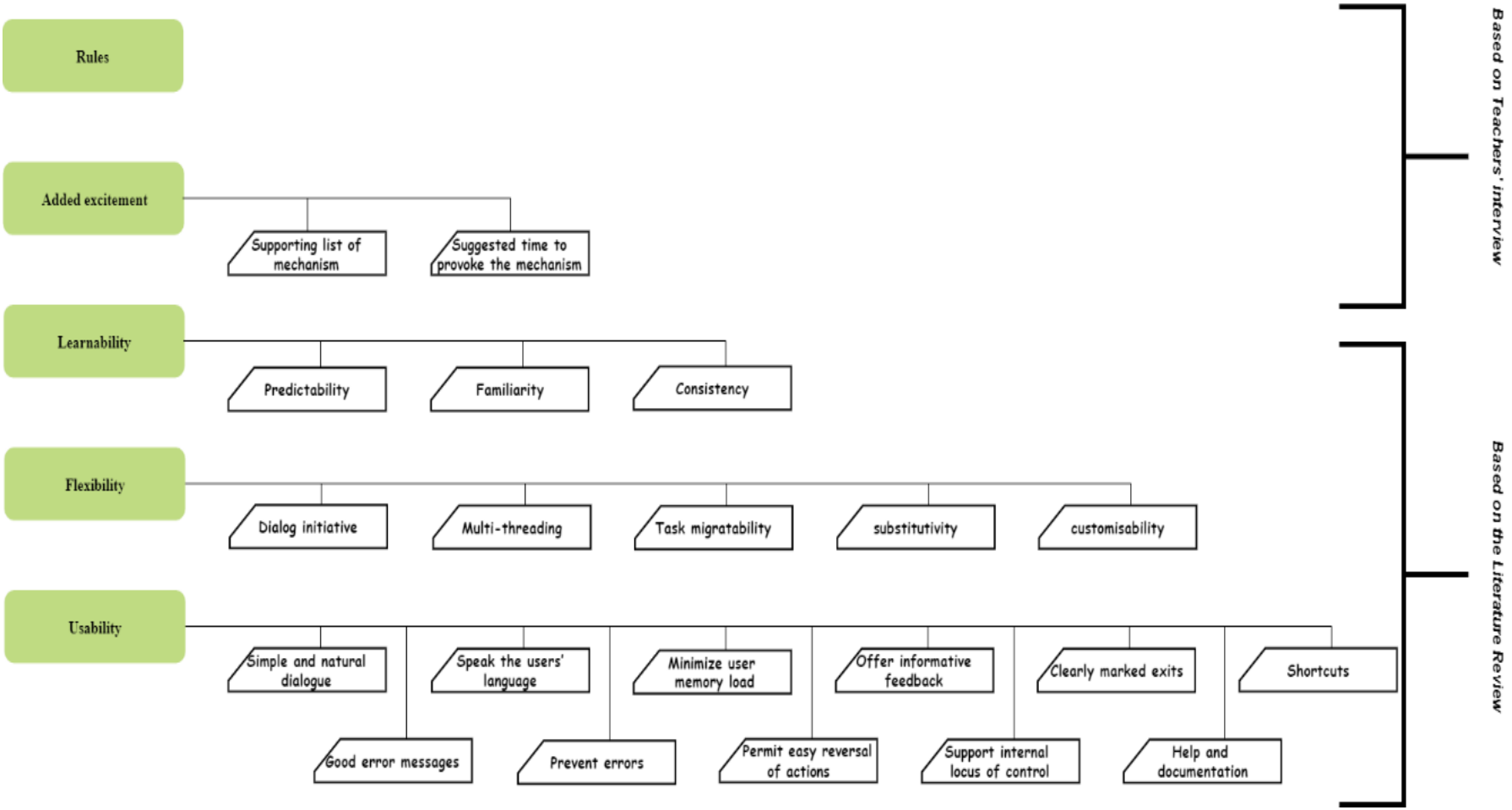


Figure 6-3. The initial Game Developers' Sub-Elements

6.6.2 The participants

All participants had game developing experience and a range of industry practise. This diverse background justified the number of participants, as discussed in Chapter 1, Section 1.7. The participants had varied experience in teaching game development that ranged from less than a year to up to 20 years, and teaching modules that included design, coding and even integrating game mechanics as tools in their module plan.

Five of the six participants considered themselves gamers, as illustrated in Table 6-10, which indicated another type of expertise of the domain—end-users of games. This helped to familiarise the participants with what to expect in terms of the game interface components.

Table 6-10. Participants' Experience Outline

Participants	Teaching game design	Industry experience	Gamer
Participant 1	✓ 20 years	✓	---
Participant 2	✓ 2 years	✓ About 15 years	✓ 34 years
Participant 3	✓ 2 years	✓ 3 years	✓
Participant 4	✓ 14 years	---	✓
Participant 5	✓ 12 years	---	✓ 45 years
Participant 6	✓ Less than 1 year	✓ 3 years	✓

Four of the six participants had industry experience, ranging from 3 years to 15 years, as illustrated in Table 6-10. For example, participants mentioned working on game applications for managing mental health, designing a storytelling game, themed attractions, historical attractions, designing an interactive experience for museum guests, etc. One of the participants who had no industry experience led students in competitions where they won a gold medal for the game they created.

The diverse range of gaming projects demonstrated a representative sample that satisfies the research criteria for game developers as domain experts to strengthen the practicality of the approach and support the holistic aspect of the AH-GPD framework.

6.6.3 Analysis discussion

This section discusses the analysis and the three content-driven themes, as illustrated in Figure 6-4: Theme 1—Participants' conceptualisation of educational games; Theme 2—Discussion of the five game developers' elements; and Theme 3—Familiarity and use of GDD.

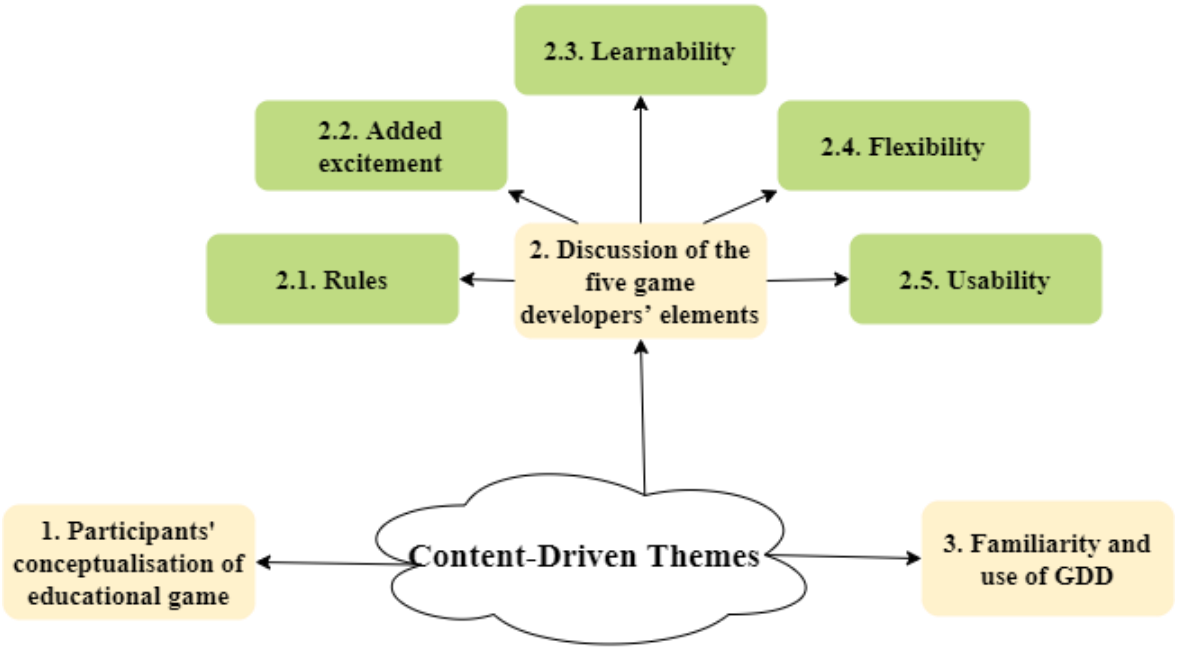


Figure 6-4. Analysis Themes

Theme 1: Participants' conceptualisation of educational games

This theme discusses the conceptualisation of an educational game from the game developers' perspective. During the interview, the participants were asked to differentiate between educational games and entertainment games, or to indicate that there is no difference (according to their experience). Even though only half of the participants had developed educational games, all agreed that there is a difference between educational games and games created for entertainment. The discussion amongst the participants revealed two types of outcomes, **learning milestones** and **developed skills**. P1, P2 and P5 highlighted the educational milestones as the main target of an educational game. In P3's perspective, an educational game is described as directing the player's attention to the information you want them to attain. Alongside the learning milestones, there are skills that a player develops through a game (i.e. motor skills, hand–eye coordination). Considering the overlap between the two types of outcomes, the focus of the design should be on the learning milestones.

The foregoing discussion emphasised the importance of Goals as a gamification element and learning milestones as a sub-element in this research. This is in line with previous findings, discussed

in Chapter 5, Section 5.4.4 and Figure 5-11, that teachers' demonstrated an instinctive utilisation of identifying goals of the game as a first step in the design, as illustrated in Table 5-4.

Theme 2: Discussion of the five game developers' elements

This theme summarises the discussion of the five game developers' elements: Rules, Added excitement, Learnability, Flexibility and Usability (see Figure 6-4). Each element is discussed individually in terms of addition, modification or recommendation.

Game developer's element 1: Rules

Rules as an element has no sub-elements, as illustrated in Figure 6-3. The participants defined rules using different perspectives and experiences. For example, P3 and P6 related Rules to engagement. P3 explained that "rules come under the engagement. Your rules include what keeps the player engaged". P6 said, "It's about identifying how you want the individuals to engage with the content". Another perception by P5 and P2 related the rules to an expected outcome. P5 stated, "what would lead to what achievement or accomplishment?". P2 explained that Rules are about completed tasks.

To summarise the discussion, most participants agreed on three sub-elements to define Rules—the event, action/trigger and outcome, where the action/trigger is to be initiated by the player, as illustrated in Figure 6-5.

Game developer's element 2: Added excitement

Added excitement has two sub-elements, represented in Figure 6-3: a supporting list of mechanisms and suggested time to provoke the mechanism. Both elements were added through previous interviews, as discussed in Chapter 5, Section5.4.4. During this interview, participants related to the Added excitement as an element in different terms, such as surprise, fun, achievement, increasing curiosity, and progression in mechanics. The **progression of the game mechanism** was mentioned by two participants, P2 and P3. P3 explained that players "learn more abilities as you go through the game, which then keeps the game fresh. Because it introduces new stuff that lets you experiment more". P2 stated that the game should "avoid revealing everything at once. More game elements would be on the screen, but the player wouldn't find them. So, he plays more times to discover". P5 further explained, "We call them achievement . . . once you win the game, they are other things you would try to achieve within the game, like finding certain things which don't necessarily change the game in some way. But you manage to find something else you could do".

The participants' discussions suggested a progression of the mechanism, which means introducing game mechanisms gradually throughout the game and avoiding overwhelming the player with too many elements at one stage. This suggestion has already been identified as a sub-element,

'suggested time to provoke the mechanism', which is one of the findings from the teachers' interviews, as discussed in Chapter 5, Section5.4.4.

Game developer's element 3: Learnability

Learnability as an element has three sub-elements—predictability, familiarity and consistency—that are discussed in Section 6.4.1. P5 referred to consistency in a game condition/rule/environment; for example, if a character is bound to lose life once they fall off the ground, then it should be the case through the whole game. "cause and effect stuff. How you control the game needs to be consistent" (P5).

One of the participants pointed out the fast change occurring in digital life these days and how familiarity has a dynamic nature. P4 stated, "Familiarity from everyday aspect to put in digital format". P6 believed that "Familiarity can be increasingly difficult, as you start to move to abstract. At that stage of everything, being Skeuomorphic, where things are designed to follow real-world objects". Skeuomorphism has been discussed as a concept related to interface design (Judah, 2013; Interaction-design.org, n.d.; Baker, 2017). For example, "Skeuomorphism is a term most often used in graphical user interface design to describe interface objects that mimic their real-world counterparts in how they appear and/or how the user can interact with them" (Baker, 2017, p.1).

The discussion with participants had no additional suggestions, and all participants agreed on the importance of the Learnability sub-elements. However, the point of familiarity keeps interfaces up-to-date in relation to whatever represents the 'current' use of end users.

Game developer's element 4: Flexibility

Flexibility as an element has five sub-elements—dialogue initiative, multi-threading, task migratability, substitutivity and customisability—that are discussed in Section 6.4.2. A point of argument was brought by P3, who stated that "Multi-threading, task migratability and substitutivity seem more of a technical documentation rather than a design document. It might be helpful to the overall framework". In contrast, P2 stated: "Task migratability: If it is a repetitive task in an educational element and you proved you can do it once, it supposed to do it for you the next time". P3's point, which is about not including the technical aspects, is applicable to some of the arguments reviewed in GDD (see Section 6.3). However, Gonzalez (2016) included a technical description section while suggesting that it should be a brief description of the technical aspect, and rich details should be placed in an individual section of the Technical Design Document. Furthermore, the assumption and constraints are described as including game technical assumptions and limitations (Salazar et al., 2012).

In summary, the concept of adding a few technical details is valid based on the current GDD review. Therefore, the sub-elements—multi-threading, task migratability and substitutivity remained in the research as part of the game developers' tasks.

Game developer's element 5: Usability

Usability as an element has 11 sub-elements: simple and natural dialogue, speak the users' language, minimize user memory load, offer informative feedback, clearly marked exits, shortcuts, good error messages, prevent errors, permit easy reversal of actions, support internal locus of control, and help and documentation. These are discussed in Section 6.4.3. Two participants (P4 and P3) suggested that accessibility should include various potential players' abilities. Another suggestion by P1 and P4 was navigability, which enables easy navigation through the game. P6 suggested that easy reversal of actions should include a redo option. Also, the importance of having tutorials in games was mentioned by P1, P3 and P4; this information should be part of the help and documentation. They explained tutorials as a demonstration for new players to make sure that players, in this case students, are familiar with the complex nature of the game mechanics. P1 specifically stated that sometimes players need informative feedback about how they can improve to achieve their goals, which should be incorporated as part of the tutorial or as hints.

The changes made to the Usability sub-elements were to add two and modify two. The added sub-elements were accessibility and navigability. The modifications were to change 'Permit easy reversal of actions' to 'Permit easy reversal of actions undo, redo', and change 'Help and documentation' to 'Tutorials and hints', as illustrated in Figure 6-5.

To summarise Theme 2, the discussion of the five game developers' elements and the modifications made to the sub-elements are illustrated in Figure 6-5 and outlined as follows:

- Rules as an element has three sub-elements: event, action/trigger and outcome.
- Usability added the sub-elements of accessibility and navigability.
- Usability has a modified sub-element, 'permit easy reversal of actions undo, redo'.
- Usability's sub-element 'Help and documentation' was replaced with 'Tutorials and hints'.

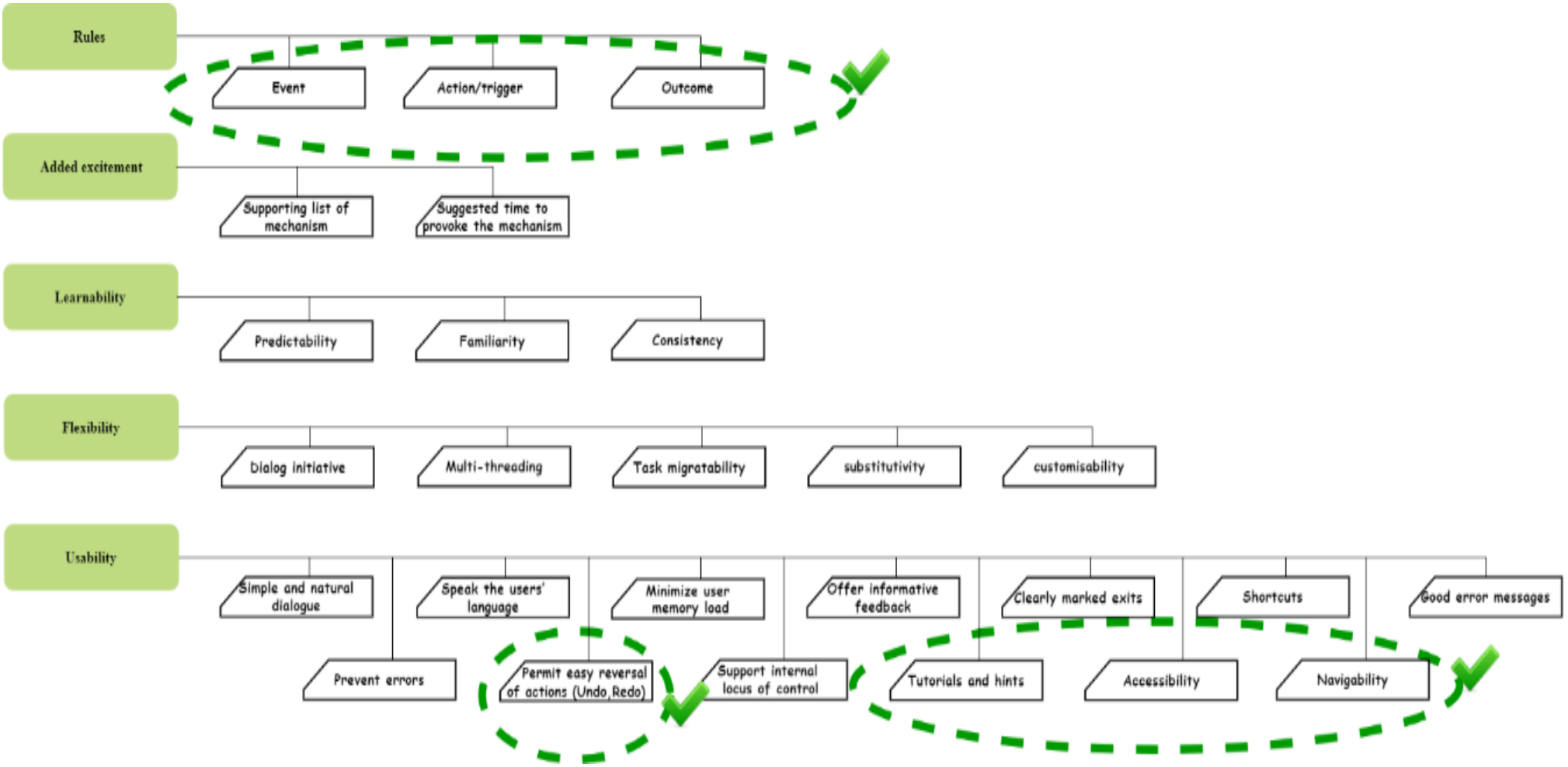


Figure 6-5. The Modifications of Game Developers' Sub-Elements

Theme 3: Familiarity and use of GDD

During the interviews, the GDD samples discussed in Section 6.3 were shown to the participants. Only two participants had used that specific type of documentation, while the others had used similar specifications to identify game requirements. For instance, P4 referred to this type of document as a collection of game mechanics. P5 mentioned that the current flow in the industry "would do something quite small, short, and focused, which gives an overview. So, people call these Vision statements or a one-sheet design". Furthermore, P1 stated that it is an "analysis technique by talking to the practitioners and the people commissioning the work", and suggested talking to stakeholders to identify the requirements. P1's point applies to this research, as the AH-GPD framework is about facilitating collaboration between teachers and game developers. Another feature was noted in the discussion by P2, who highlighted the benefits of an electronic version of GDD to facilitate team collaboration.

The foregoing discussion promotes an electronic version of Ped-GDD to facilitate better collaboration amongst stakeholders—in this research, teachers and game developers.

6.7 Findings of the Interview

The eight participants in the pilot and subsequent interview influenced changes in the framework and its elements. Firstly, the following changes were made to the AH-GPD framework, producing Version 4:

1) Add the 'feedback loop' on the black arrows connecting the teachers with the game developers, which reflects the iterative nature of the game design process, as illustrated in Figure 6-6.
2) Rearrange the elements in the box to illustrate the cycle of continuing to gamification elements before moving to HCI.
3) Label the green elements as HCI elements and gamification elements.

The changes are represented in Figure 6-6 and are numbered accordingly for illustration purposes.

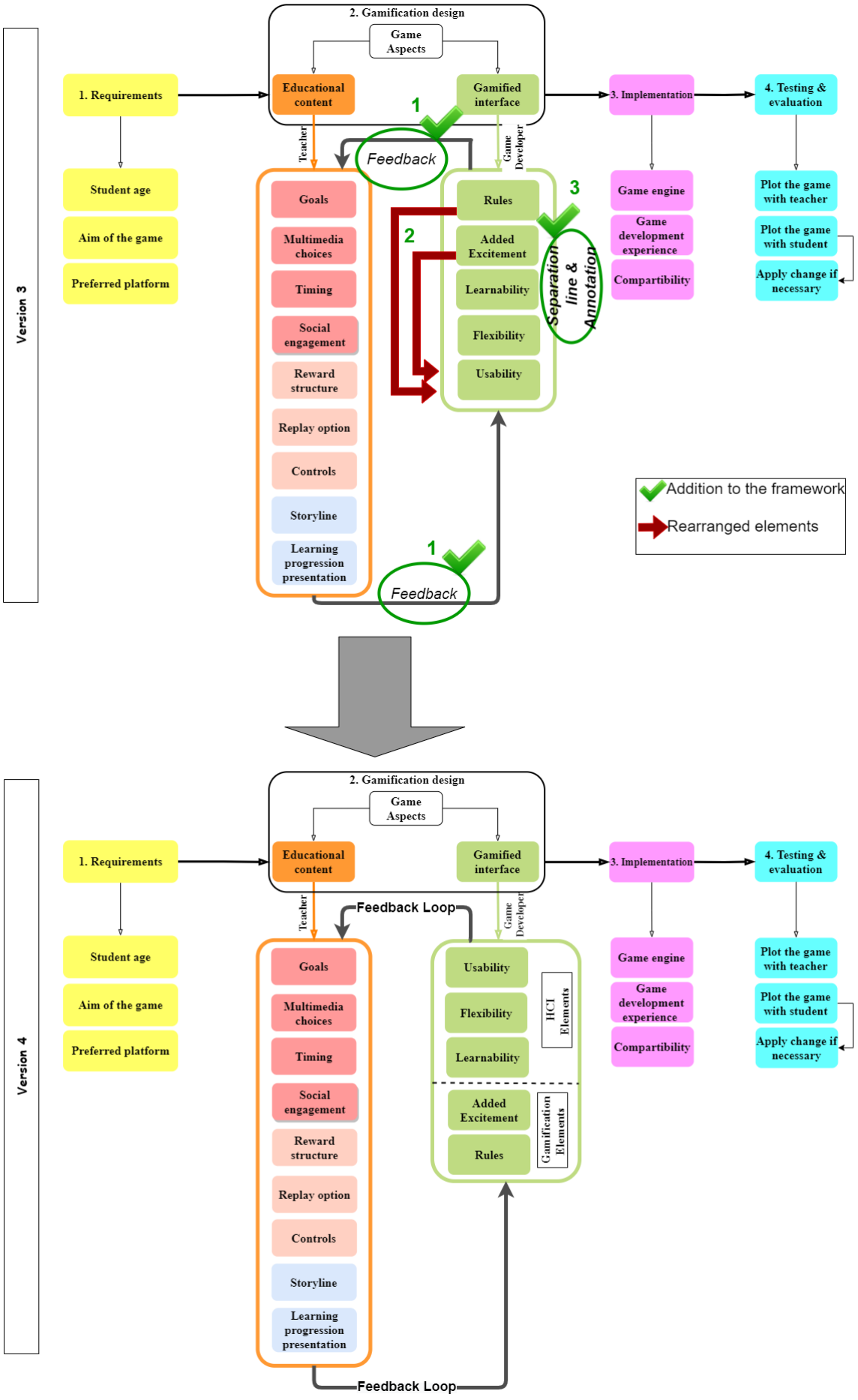


Figure 6-6. Highlight of the Changes in AH-GPD Version3 to Apply the Findings in Version 4

The modifications were made to the AH-GPD framework, which resulted in Version 4, represented in Figure 6-7.

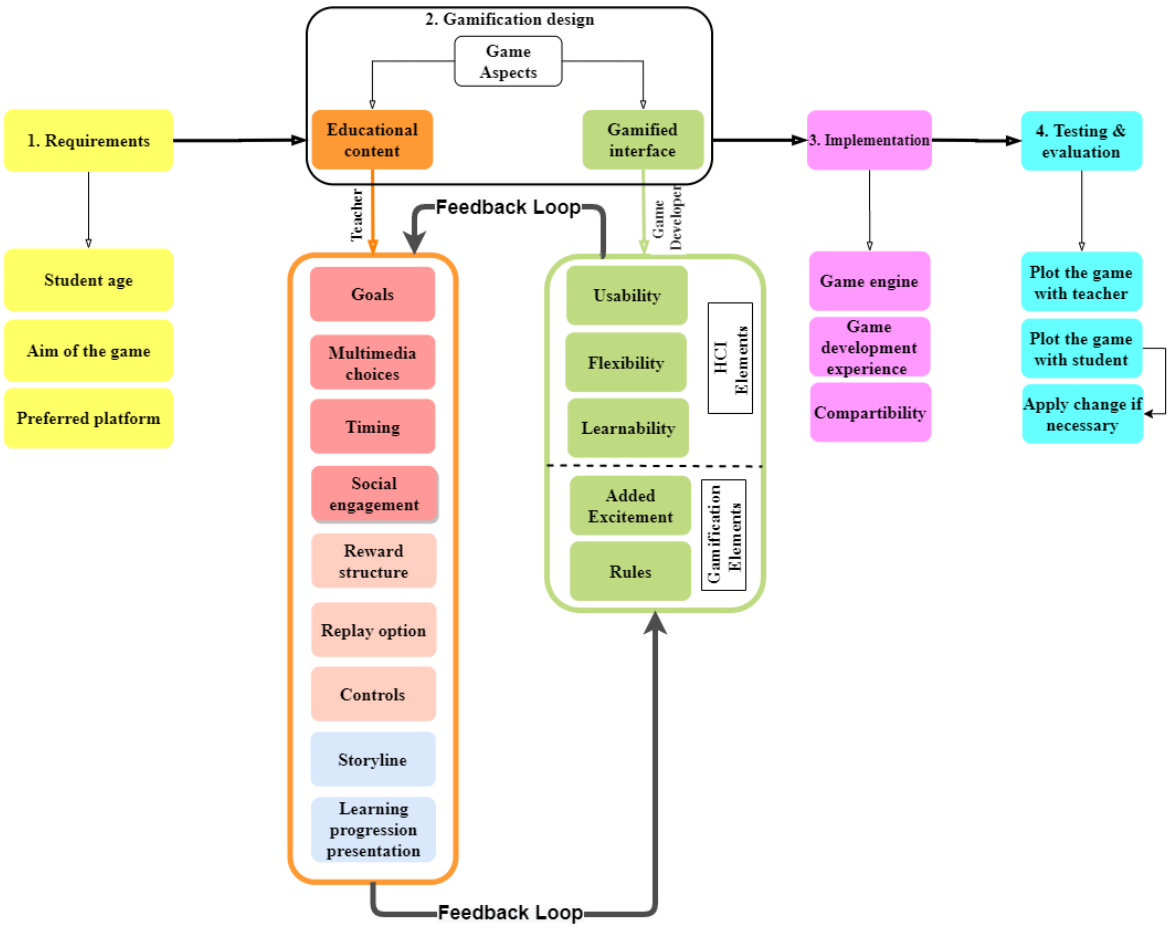


Figure 6-7. Version 4 of AH-GPD Framework

Secondly, the updates to the game developers' sub-elements, represented in Figure 6-8, are outlined as follows:

- Rules as an element has three sub-elements: event, action/trigger and outcome.
- Usability has two added sub-elements: accessibility and navigability.
- Usability has a modified sub-element: 'Permit easy reversal of actions undo, redo'.
- Usability's sub-element 'Help and documentation' was replaced with 'Tutorials and hints'.

There were a few considerations noted by the participants during the discussion; for example, having the game as a web-based game is "an unprotected gate for young audience", and designing the game as an application is a better alternative. Another point is the challenge of standardising the game design process; the participants commented on the flexibility of the framework for using the elements collectively and separately. Furthermore, the comprehensiveness of the gamification elements included in the AH-GPD framework was also noted.

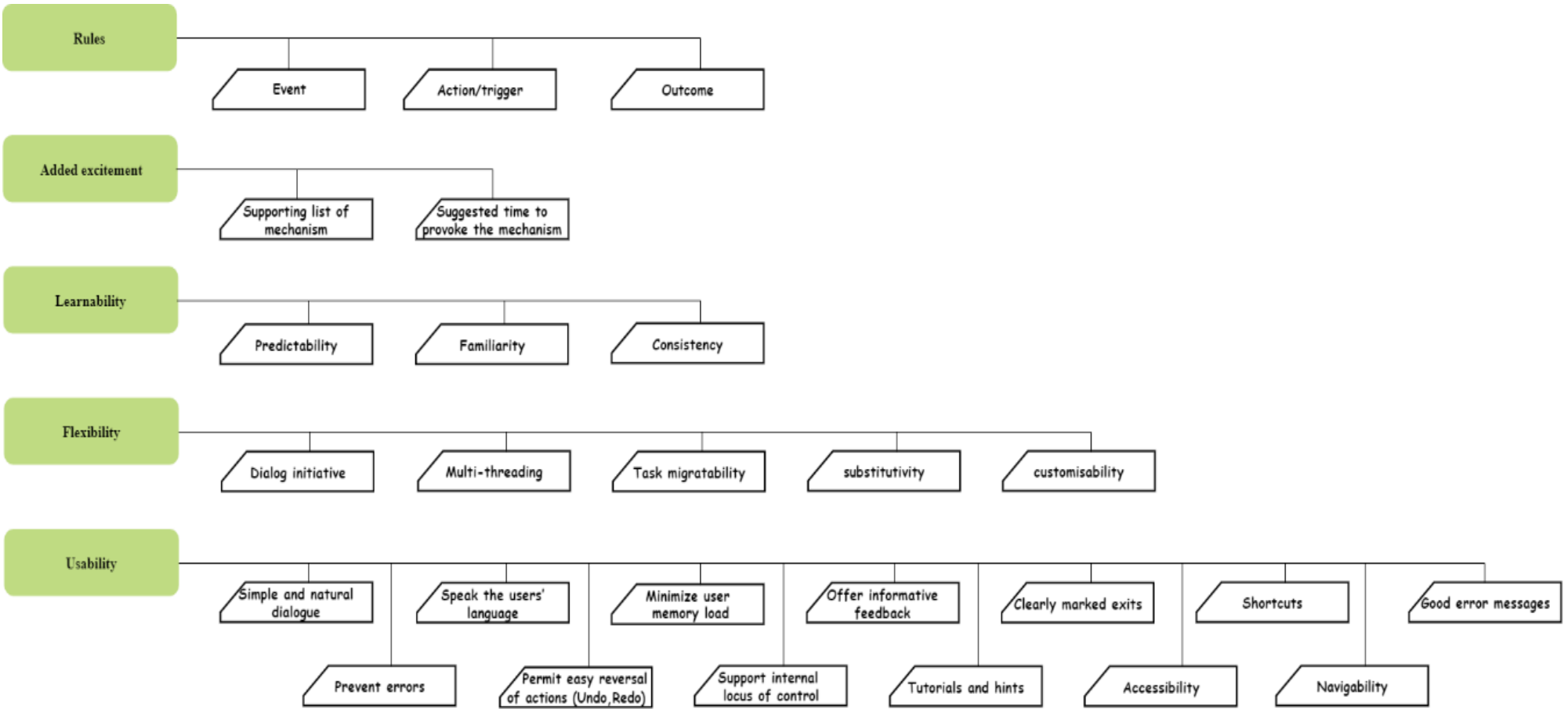


Figure 6-8. Game Developers' Sub-Elements

6.8 Conclusion

This chapter discussed the transfer of the AH-GPD framework Stage 2, 'Gamification Design', to the Ped-GDD template. The elements of stage 2 were used to build the Ped-GDD. The chapter aimed to validate the sub-elements of the AH-GPD framework using game developers as domain experts. The validation process was conducted through an interview protocol, which was designed in two stages. Initially, a pilot study was conducted to check the interview protocol with the assistance of two participants, which enabled amendments to be made to the protocol based on their comments (see Section 6.5). Secondly, the full interview study was conducted with six participants. The analysis of the interview identified three themes: participants' conceptualisation of educational games, discussion of the five game developers' elements, and familiarity and use of GDD (see Section 6.6.3). Then, the findings of the interview summarised the participants' feedback, as discussed in Section 6.7, and reflected Version 4 of the AH-GPD, shown in Figure 6-7. Furthermore, the updates to the game developers' sub-elements were presented in Figure 6-8, which was used to build the Ped-GDD alongside the sub-elements of the pedagogical elements, as discussed in Chapter 5 and Figure 5-11. The next chapter discusses the Ped-GDD to promote collaboration amongst teachers and game developers and evaluates the Ped-GDD as a research outcome from the AH-GPD framework, using a panel of experts, including both teachers and game developers.

Chapter 7. Evaluation of Ped-GDD and AH-GPD

7.1 Introduction

This chapter discusses the evaluation of the Pedagogical Game Design Document (Ped-GDD) as a research outcome. The Ped-GDD is a representation of the Agile Holistic Gamified Pedagogical Design (AH-GPD) framework, specifically Gamification Design (Stage 2). Chapter 6 discussed the construction of the Ped-GDD as an outcome of this research, with elements and sub-elements that facilitate usage by both teachers and game developers. An illustrative example of the Ped-GDD was provided to support its purpose of communicating pedagogical input as structured requirements to the game developers. The evaluation process involved a panel of experts comprised of the two stakeholders—teachers and game developers—in the design process with 15 participants in total, 10 teachers and 5 game developers. The evaluation was conducted through a semi-structured interview, and the criteria were adopted from the Technology Acceptance Model (TAM) for research purposes. The evaluation included six elements: easy to learn; easy to use; usefulness; comprehensiveness; adaptability and intention to use in the future.

7.2 Context

This chapter evaluates the Ped-GDD with a panel of experts, as illustrated in Figure 7-1. The use of experts to evaluate information systems has been demonstrated in a variety published work (Beecham et al., 2005; Sánchez-Prieto et al., 2016; Alharbi, 2017; Alyami, 2017). The evaluation included 10 teachers and 5 game developers with diverse backgrounds and expertise to satisfy the research needs, as suggested by Nielsen (1993) who recommended five participants for interviews and 6-9 for focus groups, as discussed in Chapter 1, Section 1.9.

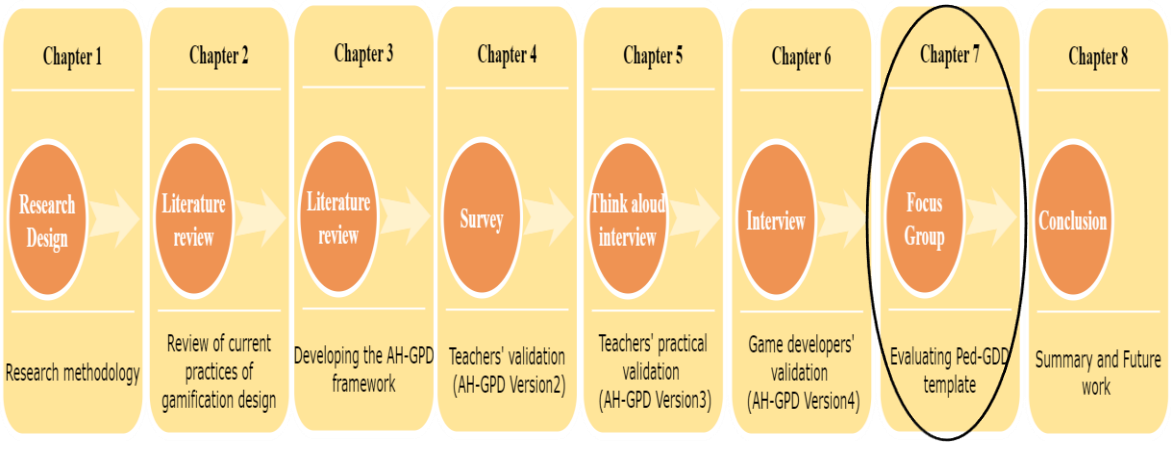


Figure 7-1. Chapter 7 in the Thesis Layout

The discussion of this chapter has four main components, as illustrated in Figure 7-2. Firstly, the interview design includes the evaluation criteria and Likert scale discussed in Section 7.3. Secondly, the participants' profiles were examined, as discussed in Section 7.4. Thirdly, the chapter provides

an illustrative example of Ped-GDD, including the two collaborators—teachers and game developers—as discussed in Section 7.5. Fourthly, the evaluation discussion is given in Section 7.6. The chapter concludes with a summary of the findings from all participants and highlights recommendations and strengths of the Ped-GDD.

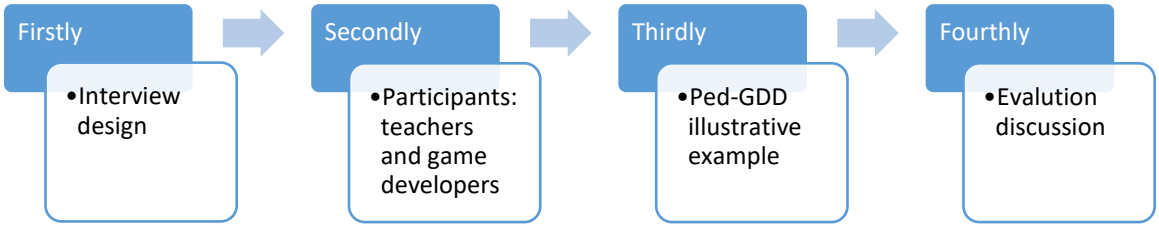


Figure 7-2 Chapter 7 Outline

7.3 Interview Design

The interview followed a semi-structured approach that allowed time and space for follow-up questions, as discussed in Chapter 1, Section 1.6.2. The interview questions are referenced in Appendix G.1, and the questions outline is shown in Figure 7-3. Open-ended questions were used in the last part of the interview to solicit the participants' opinions on the Ped-GDD and the overall research (Sánchez-Prieto et al., 2016). The participants were shown a presentation explaining the research aim and the interview goal, which are referenced in Appendix G.2. Furthermore, a printed version of the Ped-GDD example was available during the interview to ensure that the participants could relate to the evaluation accurately.

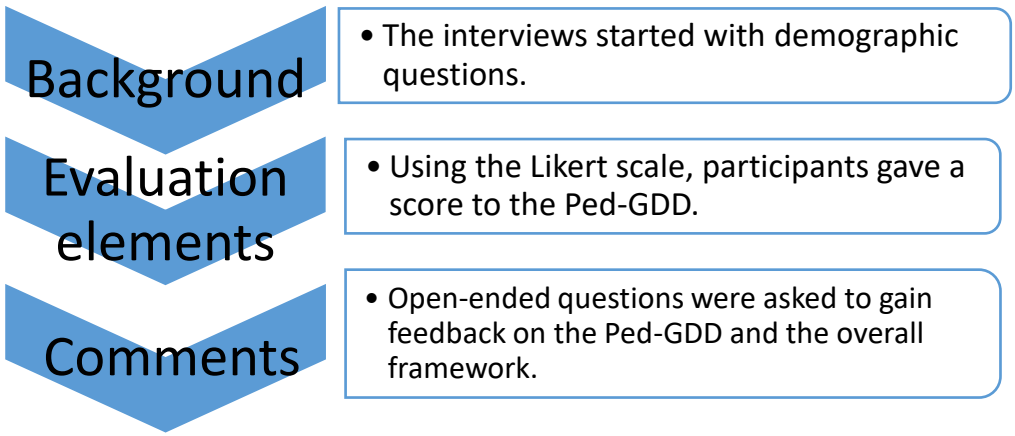


Figure 7-3 Interview Questions Outline

7.3.1 Evaluation criteria

In this research context, the evaluation conducted with end-users to measure their acceptance of the Ped-GDD. For example, a software system designed to share documents amongst an institution

staff. The system enables a successful sharing of the documents shows a successful validation of the system. However, an evaluation of that system would examine the interface with end-users to measure the interface acceptance and participants willing to use it. Therefore, the interview questions were designed using TAM, which includes perceived usefulness, perceived ease of use, attitude towards the use and external variables, as shown in Figure 7-4.

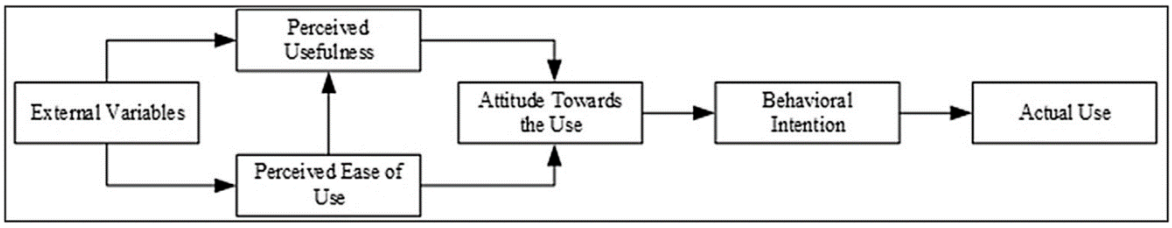


Figure 7-4. TAM (adopted from Sánchez-Prieto et al., 2016)

TAM has been widely applied in different learning areas, including education (Sánchez-Prieto et al., 2016), e-learning (Persico et al., 2014; Mohammadi, 2015; Abdullah & Ward, 2016), Massive Open Online Courses (MOOCs) (Wu & Chen, 2017), mobile learning (Alshurideh et al., 2019) and cloud computing (Bhatiasevi & Naglis, 2016). Some researchers extended TAM, while some used simpler versions depending on their research. Sánchez-Prieto et al. (2016) discussed the use of TAM and the customisation of the model over the years to accommodate different research purposes. The evaluation elements included in this research are easy to learn, easy to use, usefulness, comprehensiveness, adaptability to various levels of computer literacy and Intention to use, as illustrated in Table 7-1

Table 7-1. Evaluation Elements

Evaluation elements	**Definition**	**Adapted from**
Easy to learn	The degree to which a participant believes that users can follow the Ped-GDD in an intuitive manner	(Chin et al., 1988), (Nielsen, 1993), (Lazar et al., 2010)
Easy to use	The degree to which a participant believes that following the Ped-GDD is free of effort	(Chin et al., 1988), (Nielsen, 1993)
Usefulness	The degree to which a participant agrees that the Ped-GDD would facilitate and incorporate teachers' pedagogical input	(Nielsen, 1993), (Bhatiasevi & Naglis, 2016) cited in (Davis, 1989) (Alharbi, 2017) and (Alyami, 2017)

Comprehensiveness	The degree to which a participant believes that essential pedagogical gamification design elements are included in the Ped-GDD	(Alharbi, 2017) cited in (Beecham et al., 2005) and (Alyami, 2017)
Adaptability to various levels of computer literacy	The degree to which the expert believes that the Ped-GDD is accommodating various levels of computer literacy	(Chin et al., 1988)
Intention to use	To measure how likely teachers and game developers are to use the Ped-GDD in the future	(Alharbi, 2017) cited in (Bhatiasevi & Naglis, 2016) and (Alyami, 2017) cited in (Lambrou et al., 2014).

7.3.2 Five-point Likert scale

The use of Likert scales to measure participants' opinions on a subject has been suggested by (Lazar et al., 2010), (Leroy, 2011), (Alharbi, 2017) and (Alyami, 2017). The five-point Likert scale outlined in

Table 7-2 was adopted from (Alharbi, 2017). During the interview, the evaluation scale was shown to the participants, including the numbers and illustrative text.

Table 7-2 Five-point Evaluation Scale

	1	2	3	4	5
Easy to learn	Not at all easy to learn	Not easy to use but could be with an explanation	Easy to learn but required explanation	Easy to learn with little explanation	Very easy to learn
Easy to use	Not at all easy to use	Not easy to use but could be used with an explanation	Easy to use but required explanation	Easy to use with little explanation	Very easy to use
Usefulness	Not at all useful	Not useful but could be considered to use	Useful, but would require some modification	Useful	Very useful
Comprehensive	Not at all comprehensive	Not sufficiently comprehensive	Fairly comprehensive	Comprehensive	Very comprehensive
Adaptability to various levels of computer literacy	Very advanced level	Not simple	Fairly simple	Simple	Very simple

Intention to use	Not at all likely	Not likely, there were major modifications needed	Quite likely, but would require modification	Likely	Very likely

7.4 Participants

The evaluation included 15 participants (10 teachers and 5 game developers) with diverse backgrounds and expertise to satisfy the research need. In a similar study, six participants were used to evaluate the use of mobile technology by teachers using TAM (Sánchez-Prieto et al., 2016).

7.4.1 Teachers

This part discusses the evaluation conducted with the 10 teachers. The participants had diverse backgrounds and teaching experience, which varied from less than 1 year to 20 years. There were three primary school teachers, three intermediate school teachers and four from high school, as illustrated in Table 7-3. The variety of the sample extended to include teachers from private and public schools. Nine of the ten participants used games in their classes. The subjects they taught included social science, mathematics research skills and Arabic-language religious education. The diverse expertise demonstrated a representative sample that satisfied the research criteria for teachers as domain experts to the Ped-GDD, as discussed in Chapter 1, Sections 1.7 and 1.9.

Table 7-3. Teachers' Experience Outline

Level	Participants	Teaching experience (in years)	Using games
Primary	Participant 1	2	✓
	Participant 2	11	✓
	Participant 3	4	✓
Intermediate	Participant 4	Less than 1	✓
	Participant 5	9	✓
	Participant 6	8	✓
High school	Participant 7	20	---
	Participant 8	15	✓
	Participant 9	13	✓
	Participant 10	11	✓

7.4.2 Game developers

This part discusses the evaluation conducted with the five game developers. The participants had game developing experience with a range of commercial practise, as outlined in Table 7-4. They had varied experience in teaching game development that ranged from less than 1 year to 20 years, and teaching modules that included design, coding and integrating game mechanics as a tool in their module plan. This diverse background demonstrated a representative sample that satisfied the research criteria for game developers as domain experts to the Ped-GDD, and justified the number of participants, as discussed in Chapter 1, Sections 1.7 and 1.9.

Table 7-4. Game Developers' Experience Outline

Participants	Teaching game design	Commercial experience	Gamer
Participant 1	2 years	About 15 years	✓
Participant 2	2 years	3 years	✓
Participant 3	14 years	None	✓
Participant 4	Less than 1 year	3 years	✓
Participant 5	20 years	✓	None

7.5 Ped-GDD Illustrative Example

The illustrative example is based on a scenario of learning English letters in a game for both parts of the Ped-GDD. The teachers' part is shown in Table 7-5, and the flow of the table is illustrated in Figure 7-5. The Goal as an element represents an essential point in educational games according to game developers, as discussed in Chapter 6, Section 6.6.3 Furthermore, goals represent the start of the design process for teachers, as discussed in Chapter 5, Section 5.4.4.

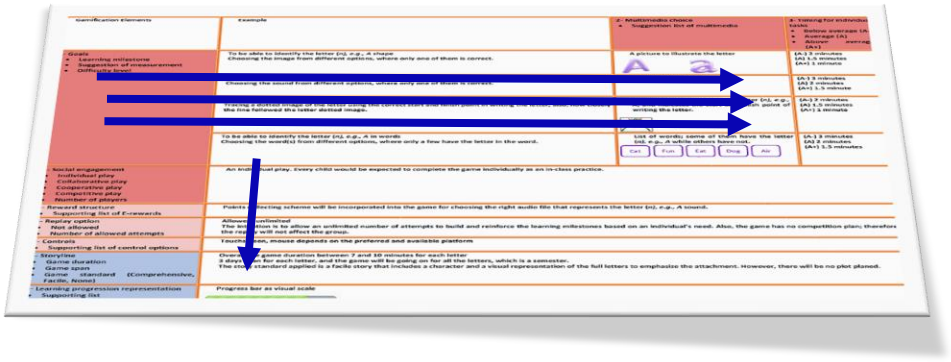


Figure 7-5. Miniature to Demonstrate the Ped-GDD Flow

Several notes on the teachers' part of the Ped-GDD are outlined as follows:

- Each milestone has to be individually associated with Multimedia choice and Timing.

- The flow of the Ped-GDD is illustrated with blue arrows in the model in Figure 7-5 and in the enlarged version shown in Table 7-5.
- The learning milestones are cumulative levels of difficulty, and there is no point in adding numbers as they are already in chronological order, as indicated with the green arrow in Table 7-5.
- The numbers added to the elements suggest a path for the design process and do not indicate any level of importance.

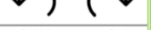
Table 7-5 An Illustrative Scenario of the Teachers' Part of the Ped-GDD

This lesson scenario is to enable students to learn English alphabets from A-Z (26 letters). The example scenarios can be applied to all the letters. The target audience for these English alphabets is early-stage learners.			
Gamification Elements	**Example**	**2- Multimedia choice** • **Suggestion list of multimedia**	**3- Timing for individual tasks** • **Below average (A-)** • **Average (A)** • **Above average (A+)**
1- Goals • **Learning milestone** • **Suggestion of measurement** • **Difficulty level**	**To be able to identify the letter (*n), e.g., A* shape** **Choosing the image from different options, where only one of them is correct.**	**A picture to illustrate the letter** 	**(A-) 2 minutes** **(A) 1.5 minutes** **(A+) 1 minute**
	To be able to identify the letter (*n), e.g., A* sound **Choosing the sound from different options, where only one of them is correct.**	**Audio files to play the sound** 	**(A-) 3 minutes** **(A) 2 minutes** **(A+) 1.5 minute**
	To be able to how to write the letter (*n), e.g., A* **Tracing a dotted image of the letter using the correct start and finish point in writing the letter, also, how closely the line followed the letter dotted image.**	**A dotted image illustrates the letter (*n), e.g., A*, and indicates the start and finish point of writing the letter.** 	**(A-) 2 minutes** **(A) 1.5 minutes** **(A+) 1 minute**
	To be able to identify the letter (*n), e.g., A* in words **Choosing the word(s) from different options, where only a few have the letter in the word.**	**List of words; some of them have the letter (*n), e.g., A* while others have not.** 	**(A-) 3 minutes** **(A) 2 minutes** **(A+) 1.5 minutes**

4- Social engagement • Individual play • Collaborative play • Cooperative play • Competitive play • Number of players	An Individual play. Every child would be expected to complete the game individually as an in-class practice.
5- Reward structure • Supporting list of E-rewards	Points collecting scheme will be incorporated into the game for choosing the right audio file that represents the letter *(n), e.g., A* sound.
6- Replay option • Not allowed • Number of allowed attempts	Allowed, unlimited The intention is to allow an unlimited number of attempts to build and reinforce the learning milestones based on an individual's need. Also, the game has no competition plan; therefore, the replay will not affect the group.
7- Controls • Supporting list of control options	Touchscreen, mouse depends on the preferred and available platform
8- Storyline • Game duration • Game span • Game standard (Comprehensive, Facile, None)	Overall, the game duration between 7 and 10 minutes for each letter 3 days span for each letter, and the game will be going on for all the letters, which is a semester. The story standard applied is a facile story that includes a character and a visual representation of the full letters to emphasize the attachment. However, there will be no plot planed.
9- Learning progression representation • Supporting list	Progress bar as visual scale 

The evaluation of the game developers' part of the Ped-GDD, which includes different elements, follows the same game scenario as shown in Table 7-6. Although Table 7-5 and Table 7-6 include different elements, the participants were introduced to the other group's Ped-GDD as part of the interview to offer comments, if needed.

Table 7-6. An Illustrative Scenario of the Game Developers' Part of the Ped-GDD

This lesson scenario is to enable students to learn English alphabets from A-Z (26 letters). The example scenarios can be applied to all the letters. The target audience for these English alphabets is early-stage learners.	
Elements	Example
Rules (engagement, expected outcome) • Event • Action/trigger • Outcome	1. E: Moving from letter recognition *Goal1* to sound *Goal2* A:Next button O: A sign of achievement 2. E: drawing the letter A A: start drawing then the system will point the starting points of writing the letter by measuring similarity/ how closely the player draws the line to the original lines provided O: Reward or an indicator of successful tracing the letter , going to a loop of trying or not 3. E: Replace the dotted picture with starting points that form the letter A: Trying to write the letter for a second time O: Increased challenge and achievement
Added Excitement (Progression) • Supporting list of mechanism • Suggested time to provoke the mechanism	1. Bonus level • Multiple letters joined handwriting tasks. • Achieving 5 letters 2. Media • customised more character • Visited application more than 3 times 3. Music • Changing the musical background • Mastered more than 3 letters 4. More customisation options • Points will be used to buy new themes and characters • When players collected 10 points and/or more
Learnability • Predictability • Familiarity • Consistency	Following the same layout and media choices to reach the same goals for all the letters Familiarity in keeping the icons up-to-date 
Flexibility • Dialogue initiative • Multi-threading • Task migratability • Substitutivity • Customisability	In case the player not interacting with the interface, the game would activate hint to keep the players' attention. Customisability, colours of drawing in tracing the letters
Usability	
• Simple and natural dialogue • Speak the users' language	The game is intended for a young audience; therefore, it will mostly follow the current use of emojis and icons 'Educational Fonts' consideration for children of young age, and vocabulary related to the target players' age.
• Minimise user memory load	Allowing the user to save the input needed for login Providing hints and suggestion of related interface
• Offer informative feedback	Direct the user for the way to reach the goal
• Clearly marked exits	Following the exit sign or door
• Shortcuts	Through consistent layout of the interface
• Good error messages	(Try clicking this) with pointing arrow
• Prevent errors	Through user interface testing
• Permit easy reversal of actions (undo, redo)	Appears on all interfaces that include a task to be performed by the player 
• Support internal locus of control	The focus of the task in hand will be drawn through a higher brightness while the full layout of the interface frame layout will be shaded in lower brightness
• Tutorials and hints	The system will suggest the start of writing the letter. The system will have a pointed arrow to direct the user to the audio file play command. In general, the game will have a flashing light bulb to indicate available hint 
• Accessibility	This game is intended for average players with no learning difficulties, no special needs accessibility is required
• Navigability	Previous  Next 

7.6 Evaluation Discussion

7.6.1 Average score

The teacher participants came from three levels of teaching—primary, intermediate and high school—as outlined in Table 7-3. Although the teachers belonged to different groups, the average evaluation on each element was similar, with a difference of less than 0.5, as illustrated in Figure 7-6. Therefore, the discussion of each evaluation element tracks the overall teachers' evaluations without discussing the differences among the groups. The one noticeable difference was in the intermediate school average for the '**intention to use'** element. The reason for this difference might be related to the teachers' topics of religious education, social sciences and Arabic language. According to one of the participants who teaches religious education, the subject is more related to storytelling rather than games.

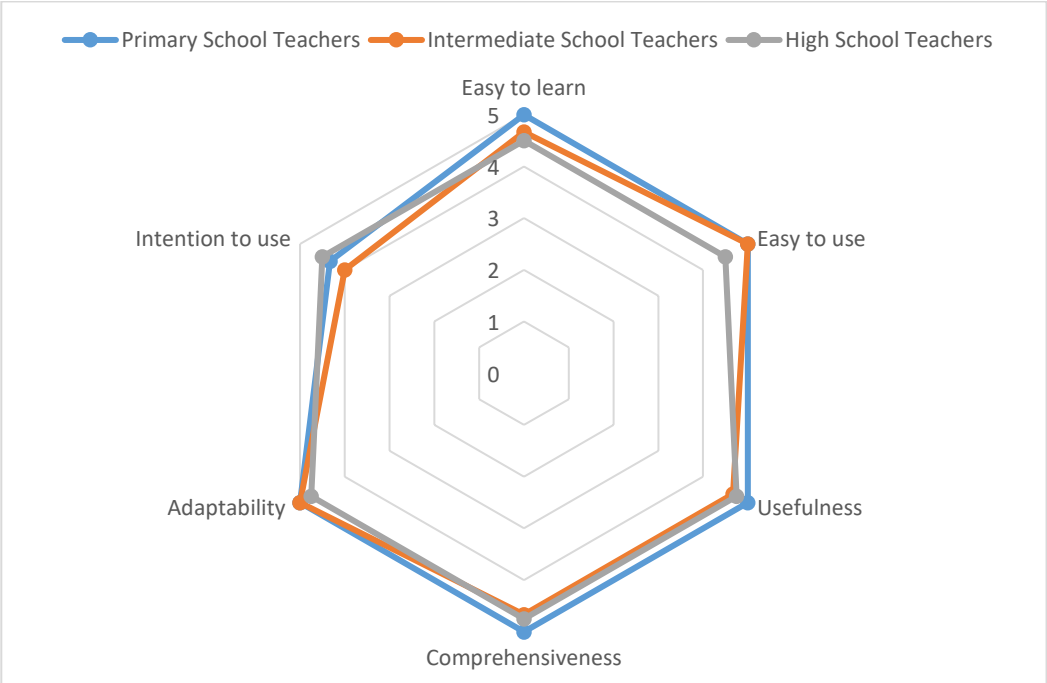


Figure 7-6. Comparison of Averages for Teachers from All Three Levels (Primary, Intermediate and High School)

Table 7-7 shows the overall evaluation averages between the two participant groups (teachers and game developers), with a close correlation, as illustrated in Figure 7-7.

Table 7-7. Averages Comparison

	Easy to learn	**Easy to use**	**Usefuln-ess**	**Comprehensiv-eness**	**Adaptabi-lity**	**Intention to use**
Teachers' average	4.7	4.8	4.8	4.8	4.9	4.3
GD Average	4.2	4.2	4.8	4	4.6	3.8

Table 7-7. illustrates the average scores for the evaluation elements by both teachers and game developers, and the difference ranged from 0.3 to 0.8. Teachers evaluated the '**adaptability to various levels of computer literacy'** as the highest score. Interestingly, this evaluation element was based on a barrier that teachers demonstrated earlier, as discussed in Chapter 5, Sections 5.3.3 and 5.5; therefore, the research contributes to eliminating this obstacle. '**Usefulness'** received the same evaluation score from both groups and was the highest score for the game developers. At the same time, it was the second-highest for teachers alongside '**easy to use**' and '**comprehensiveness**', as outlined in Table 7-7. '**Intention to use**' the Ped-GDD in the future was an evaluation element even though it received the lowest score by both teachers and game developers, which is discussed individually in Section 7.6.7.

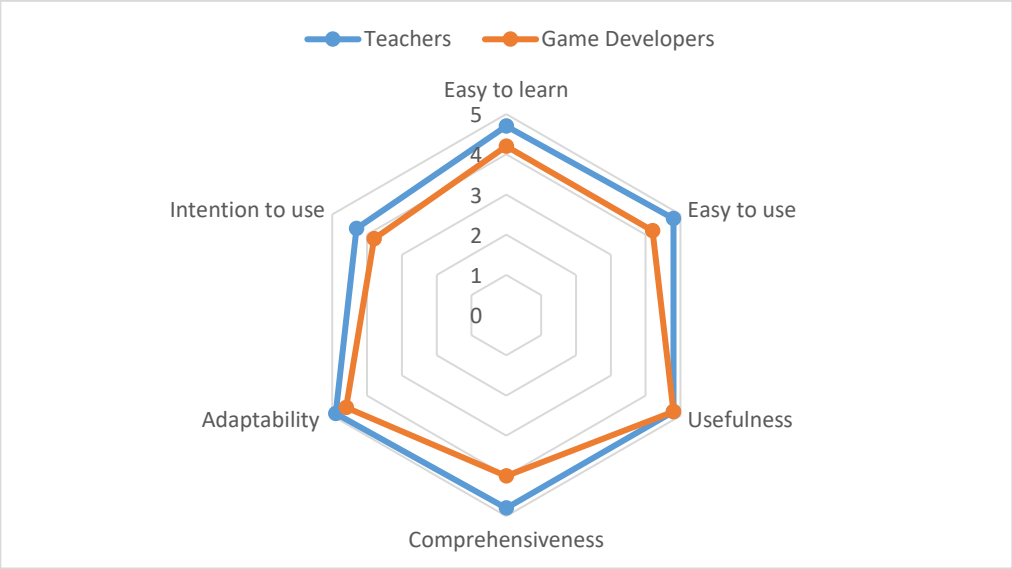
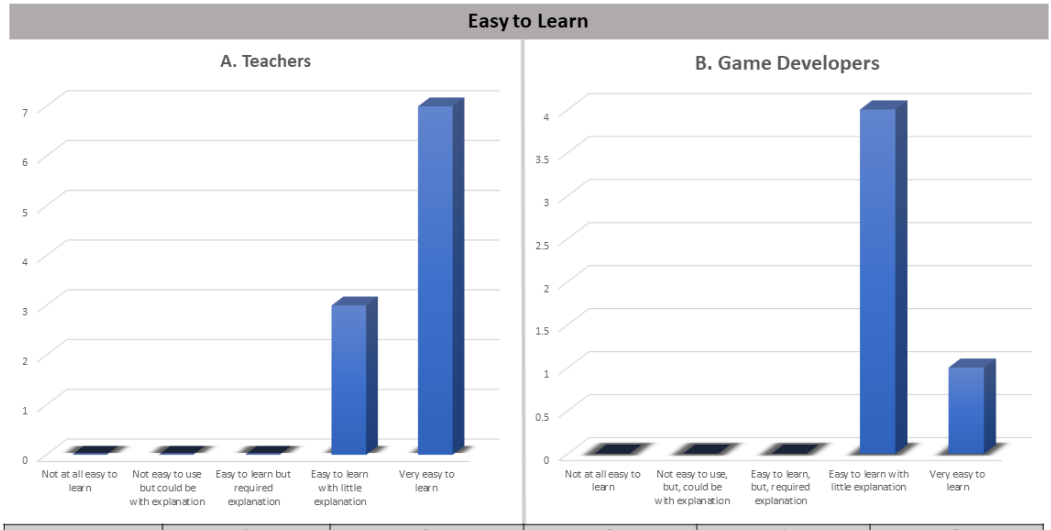


Figure 7-7. Compared Averages of Teachers and Game Developers

7.6.2 Easy to learn

According to Lazar et al. (2010), ease of use is one of the highly important elements in measuring technology adoption; however, it is also one of the least studied. In this research, ease of use is described as *the degree to which a participant believes that users can intuitively follow the Ped-GDD*. Both teachers and game developers fell on the positive side of the scale. Seven teachers rated the Ped-GDD as 'very easy to learn' (5), and three teachers rated it 'easy to learn with little explanation'(4), as illustrated in Section A in Figure 7-8 . In the same figure, Section B shows the evaluations of the game developers, of whom four rated the Ped-GDD as 'Easy to learn with little explanation'(4), and one rated it as 'very easy to learn' (5).



The x-axis enlarged text	1	2	3	4	5
	Not at all easy to learn	Not easy to use but, could be with an explanation	Easy to learn but, required explanation	Easy to learn with little explanation	Very easy to learn

Figure 7-8. Easy to Learn

7.6.3 Easy to use

In this research, ease of use is described as *the degree to which a participant believes that completing the Ped-GDD is free of effort*. Nine teachers thought that Ped-GDD was 'very easy to use' (5), while only one believed it was 'easy to use but required explanation' (3), as illustrated in Section A of Figure 7-9. On the other hand, game developers' opinions varied, as illustrated in Figure 7-9, Section B. Four participants were on the positive side, as two rated the Ped-GDD as 'very easy to use' (5) and two rated it as 'easy to use with little explanation' (4). Interestingly, one game developer perceived it as 'easy to use but required explanation' (3). The reason for this rating might be due to the diverse disciplines the participants represent. Possibly, the participants considered the clarity of applying the concept of the Ped-GDD in terms of their own field rather than generally.

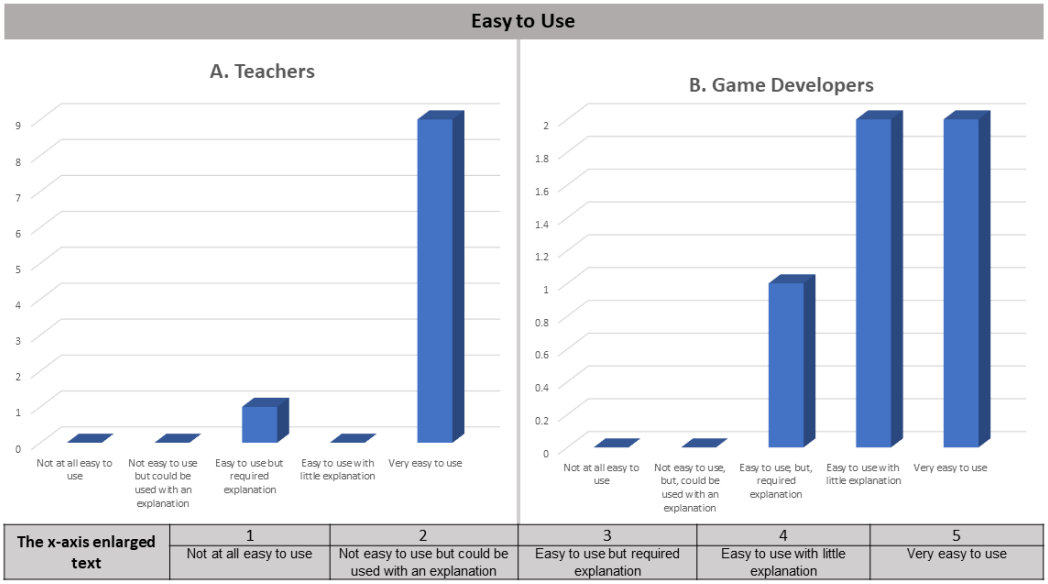


Figure 7-9. Easy to Use

7.6.4 Usefulness

Usefulness as an evaluation element was explained to the participants as *the degree to which a participant agrees that the Ped-GDD would incorporate teachers' pedagogical input*. As shown in Section A in Figure 7-10, eight teachers rated the Ped-GDD as 'very useful' (5), and two rated it as 'useful' (4). Figure 7-10 Section B indicates that game developers also gave positive ratings; four believed it is 'very useful' (5), and one rated it as 'useful' (4).

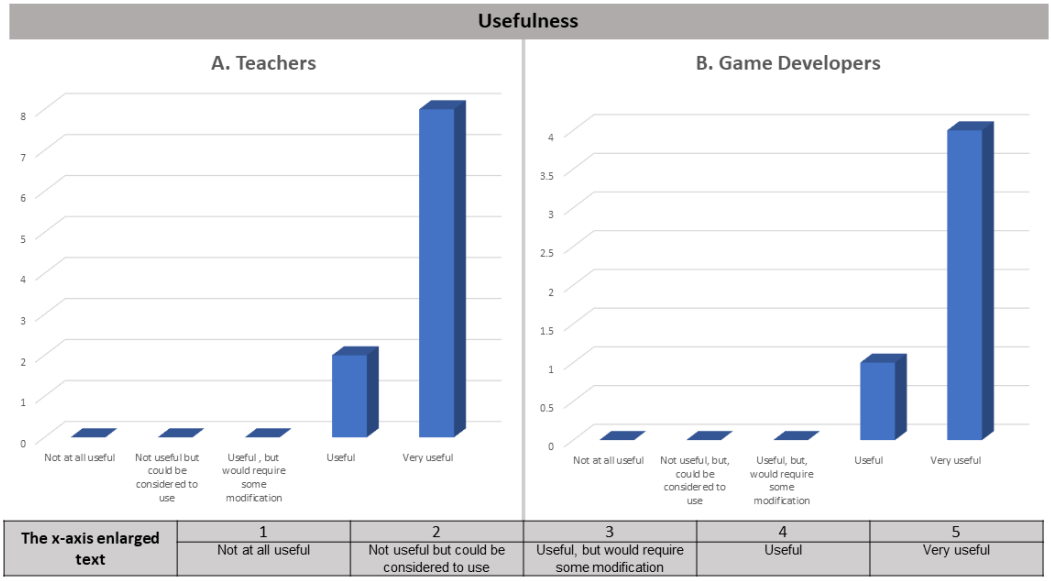


Figure 7-10. Usefulness

7.6.5 Comprehensiveness

Comprehensiveness was described as *the degree to which a participant believes that essential pedagogical gamification design elements are included in the Ped-GDD*. Eight teachers rated the Ped-GDD as 'very comprehensive' (5), and two rated it as 'comprehensive' (4), as illustrated in Figure 7-11, Section A. Likewise, Section B shows that three game developers rated the Ped-GDD

as ’comprehensive’ (4), while one rated it as ‘very comprehensive’ (5), and one scored it as ‘fairly comprehensive’ (3).

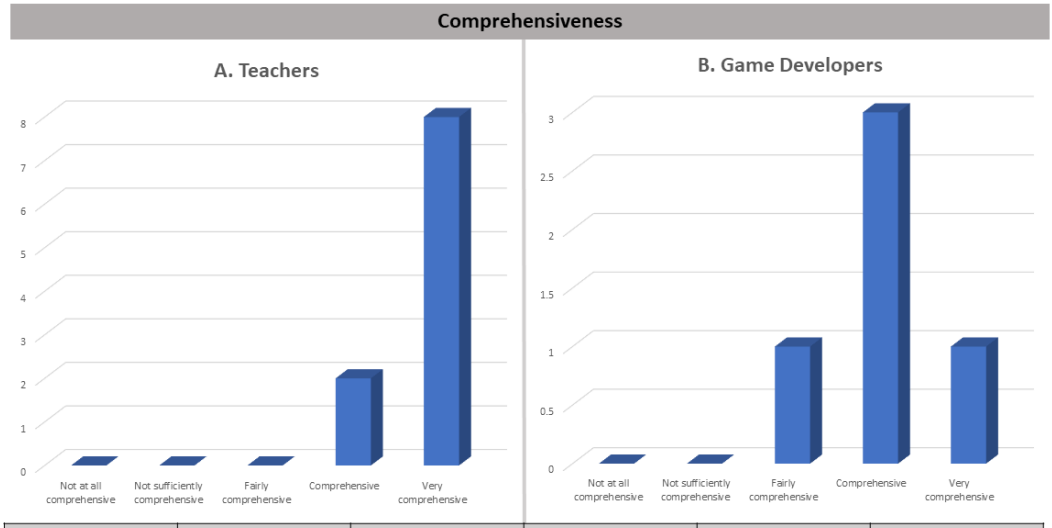


Figure 7-11. Comprehensiveness

7.6.6 Adaptability to various levels of computer literacy

In this research, adaptability refers to *the degree to which the expert believes that Ped-GDD is accommodating various levels of computer literacy*. The significance of adaptability to various levels of computer literacy was indicated by teachers at an early stage of this research, as discussed in Chapter 5, Sections 5.3.3 and 5.5, which suggested intimidation of technicality. Here, most of the teachers' ratings fell on the positive side of the scale, as illustrated in Section A in Figure 7-12. Nine teachers rated the Ped-GDD as ‘very simple’ (5), and one rated it as ‘simple’ (4). Meanwhile, three game developers selected ‘very simple’ (5), and two selected ‘simple’ (4), as illustrated in Section B in Figure 7-12.

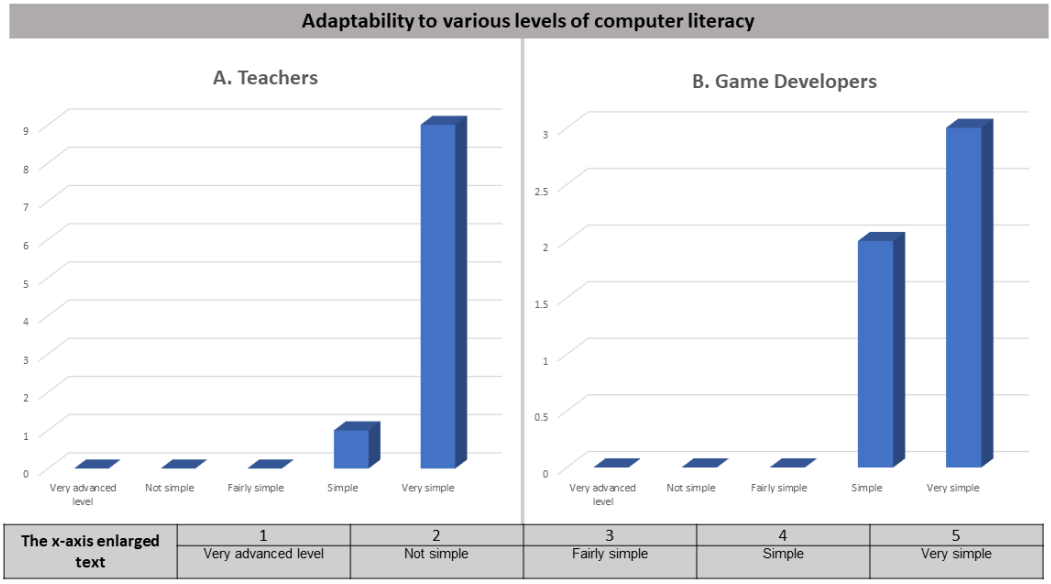
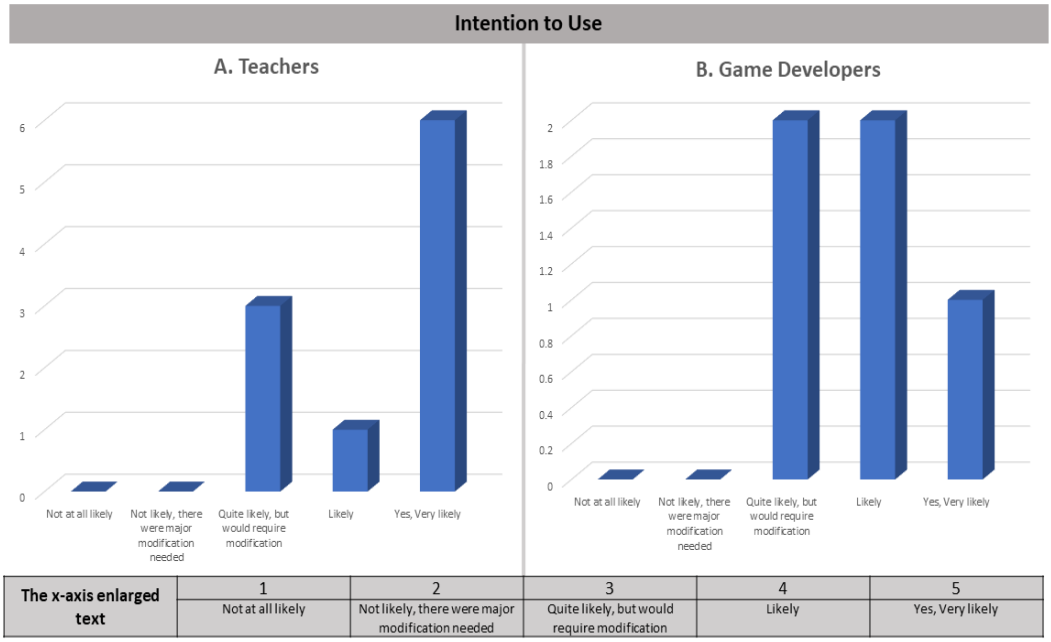


Figure 7-12. Adaptability

7.6.7 Intention to use

The intention to use was described here as *how likely teachers and game developers are to use the Ped-GDD in the future*. Six teachers rated the Ped-GDD with as 'very likely to use' (5), and one rated it as 'likely to use' (4), as illustrated in Section A of Figure 7-13. While three teachers indicated they were 'quite likely to use it, but requires modification' (3), the participants did not suggest modification or addition to the format. Along the same lines, two game developers perceived the Ped-GDD as 'quite likely to use it, but requires modification' (3), however, they justified the low rating with the need for customisation of the elements. On the positive side of the scale, one developer rated it as 'very likely to use' (5), and two rated it 'likely to use' (4), as illustrated in Section B in Figure 7-13.



The x-axis enlarged text	1	2	3	4	5
	Not at all likely	Not likely, there were major modification needed	Quite likely, but would require modification	Likely	Yes, Very likely

Figure 7-13. Intention to Use

7.7 Findings for Overall Comparisons

This section summarises the main points of the findings from the interviews with all 15 participants. In the evaluations, most of the element scores were between 4 and 5, on the positive side of the scale; specifically, this included **easy to learn**, **usefulness** and **adaptability,** as outlined in Table 7-8. The noticeable differences for the remaining evaluation elements are highlighted in yellow in Table 7-8. The major evaluation elements that were rated 3 on the scale by more participants than the others were **intention to use** and **easy to use**.

Table 7-8. Comparison of Evaluation Scores Illustrated by Participants' Number

	1	2	3	4	5
Easy to learn	Not at all easy to learn	Not easy to use but could be with an explanation	Easy to learn but required explanation	Easy to learn with little explanation	Very easy to learn
Number of participants	0	0	0	7	8
Easy to use	Not at all easy to use	Not easy to use but could be used with an explanation	Easy to use but required explanation	Easy to use with little explanation	Very easy to use
Number of participants	0	0	2	2	11
Usefulness	Not at all useful	Not useful but could be considered to use	Useful, but would require some modification	Useful	Very useful
Number of participants	0	0	0	3	12
Comprehensive	Not at all comprehensive	Not sufficiently comprehensive	Fairly comprehensive	Comprehensive	Very comprehensive
Number of participants	0	0	1	5	9
Adaptability to various levels of computer literacy	Very advanced level	Not simple	Fairly simple	Simple	Very simple
Number of participants	0	0	0	3	12
Intention to use	Not at all likely	Not likely, there were major modifications needed	Quite likely, but would require modification	Likely	Very likely
Number of participants	0	0	5	3	7

Foremost, **intention to use** was the element that was rated in the neutral zone as 'quite likely, but requires modification' (3), by five participants (33%), as illustrated in Figure 7-14. Nonetheless, it is notable that 67% of the participants issued positive ratings.

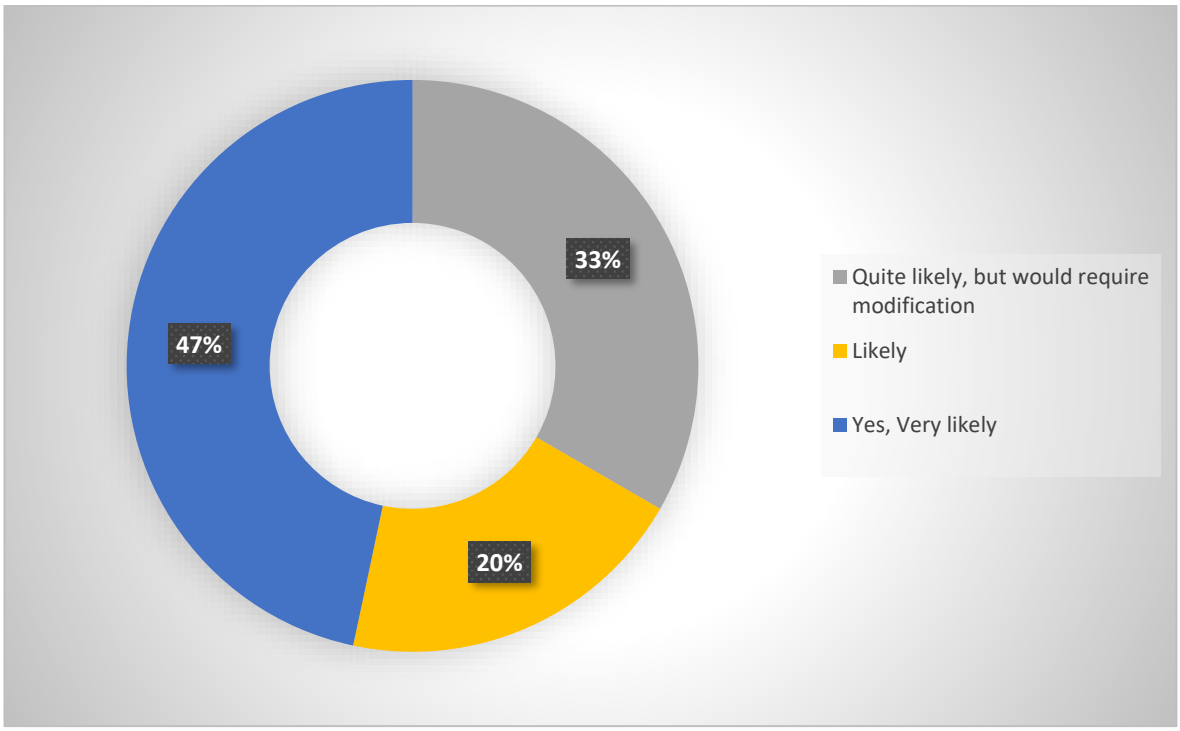


Figure 7-14. Intention to Use Score for all Participants

Furthermore, on **easy to use**, the Ped-GDD was rated in the neutral zone of 'easy to use, but requires explanation'(3), by two participants (14%), as illustrated in Figure 7-15. However, the overall majority (86%) suggested that it was easy to use, which indicated extremely positive support for the designed document from the research. A minor difference appears in **comprehensiveness**, with one participant (7%) in a neutral zone of 3.

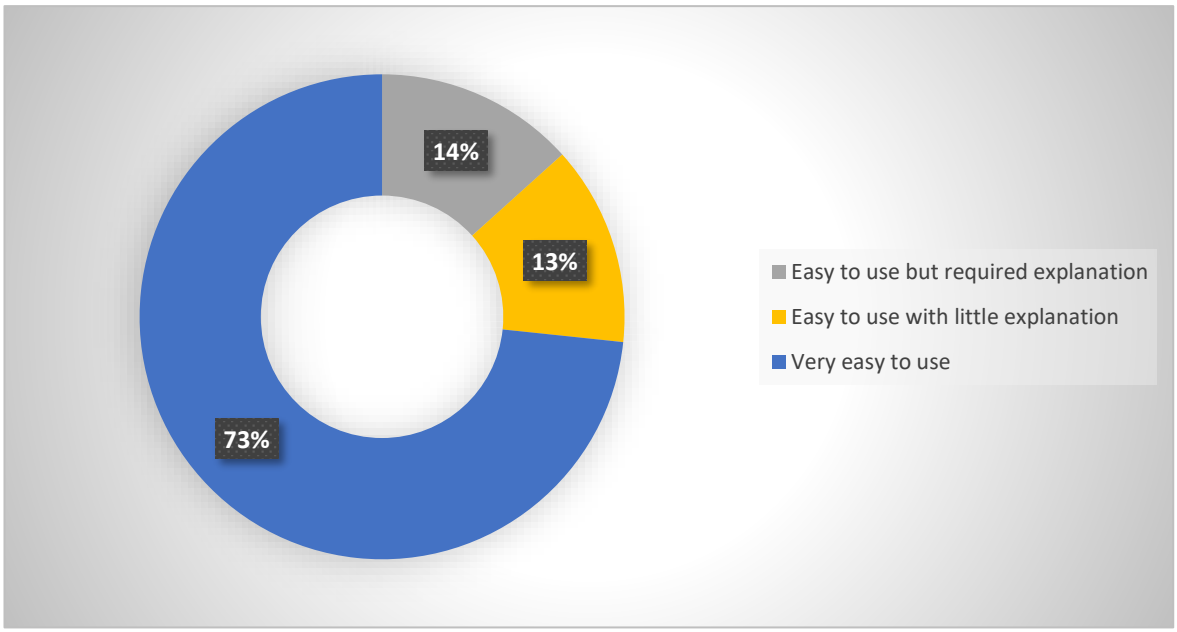


Figure 7-15. Easy to Use Score for All Participants

In summary:

- ✓ Two participants commented on the flexibility of being able to add different elements to use the elements collectively or separately.
- ✓ Participants commented on the use of images to demonstrate ideas, which indicates that an illustrative example would simplify the applicability of the Ped-GDD for other users to modify it to their needs.
- ✓ One participant commented on the clarity of the Ped-GDD.
- ✓ One participant who is teaching game design commented that students could use this framework to go from a high-level view to a more specific view, and it would help with project management.
- ✓ Two teachers suggested the need to add an evaluation of the overall learning outcomes of the game. This is an existing part of the Ped-GDD but needs to have an overall option instead of only a milestone review/assessment.

7.8 Conclusion

This chapter discussed the process of evaluating the Ped-GDD as an outcome of the research. The evaluation criteria were adapted from TAM, as discussed in Section 7.3. The evaluation included 15 participants (10 teachers and 5 game developers) with diverse backgrounds and expertise to satisfy the research needs, as discussed in Section 7.4. This was a similar premise to a study in which six participants were used to evaluate the use of mobile technology among teachers using TAM (Sánchez-Prieto et al., 2016). Since the number of participants was 15, this represents a focus group

and it is suggested in the literature that, whilst 5 participants constitutes an interview, 6–9 makes a focus group (Nielsen, 1993). The evaluation was carried out through semi-structured interviews with teachers and game developers who are the stakeholders in the pedagogical design process. The evaluation discussion was presented in a comparative manner, illustrating the evaluations of the teachers alongside those of the game developers, as outlined in Section 7.6.

The findings indicate that two elements need to be improved: the intention to use and the ease of use. Intention to use can be improved by incorporating the Ped-GDD as part of an e-government educational scheme to enable collaboration amongst teachers nationwide in educational software tools development. Furthermore, ease of use can be improved by building a repository of Ped-GDD examples of lessons to strengthen available resources. The repository would include more examples from a variety of disciplines that relate to different topics; therefore, the participants would clearly see how to apply the concept of the Ped-GDD in their own field. The participants indicated the positive effect of having the illustrative example to maximize the clarity of the Ped-GDD. The e-government incorporation of this research is discussed in the next chapter as an option for future work.

Chapter 8. Conclusion and Future Work

8.1 Introduction

This chapter provides an overview of the thesis by outlining the research excursion. The literature review discussion presents the theoretical basis and the current gamification design challenges that hinder teachers' integration in the design process. Therefore, the chapter will discuss the research aim and objectives to benefit teachers overcoming the barriers. Also, this chapter evaluates the research findings and discusses its limitation. Finally, this chapter identifies future work and potential contribution to the Ministry of Education.

8.2 Research Summary

Gamification is perceived as a dynamic state-of the art approach for learning (Skalka & Drlik, 2018). Toda *et al*. (2019) propounds the view that combining traditional and technology-supported learning methods will enrich the learning experience. Sánchez *et al*. (2020) Conducted a comprehensive study to evaluate the effectiveness of gamification as part of learning experience, with a group of 60 participants. Their research concludes using gamification as part of the learning process encouraged students and led to better learning acquisition. The current literature emphasised the positive impact of gamification on students' engagement and on the learning acquisition and improvement of their skills, as discussed in Chapter 2, Section 2.4. A challenge related to the context for conducting the present study—that is, the COVID-19 lockdown. The global pandemic has led to unprecedented measures being taken in many countries, including school closures, which poses obstacles for pupils' learning. The current pause in conventional teaching has created an opportunity to embrace a new attitude towards gamification platforms to support new learning techniques.

Kermek *et al*. (2016) discussed the interdisciplinary nature of gamification in an e-learning environment, which requires collaboration amongst different specialities, including education, IT specialists, psychology and pedagogy. Also, Hamari and Nousiainen (2015) referred to teachers in the design process as co-creators of the content and teachers and emphasised teachers' perspectives and enthusiasm effect on their adoption of games as a teaching tool. Similarly, Kapp (2012) emphasised the role of subject experts in a design team to outline the educational objectives of an educational game. This discussion puts forward the idea that teachers' input is as essential as technical experts' game programming skills.

This research promotes the synergy between teachers and game developers in the design process by developed an Agile Holistic Gamified Pedagogical Design (AH-GPD) Framework. The outcome of the research presented in Pedagogical Game Design Document (Ped-GDD) that provides a communication platform.

8.3 Review of research aim and objectives

The research aims to develops an agile and holistic framework for gamified pedagogical material that incorporates knowledge from two domain experts—teachers and game developers—in the design process. The findings of this research have been part of eight publication. Table 8-1 outlines the research objectives and the methods used to accomplish them—indicates the chapters discussing them, and published segments of the research.

Table 8-1. Research Objectives and Methods in Relation to Chapters and Publications

Objective	Method of Investigation	Chapter Number
1. To conduct a literature review of the gamification concept and its impact on students	A literature search using academic search engines and reviewing 125 articles	2
2. To identify, within the literature review, the practices of gamification design in the learning context, and teachers' roles as key stakeholders in gamification design.		2
3. To identify the gamification elements related to learning through a comprehensive/broader literature search that includes gamification mechanics, dynamics and related aspects		3
4. To develop a framework that supports teachers in gamification design		3
5. To conduct a survey of primary school teachers in KSA to categorise the gamification elements	A pilot with 7 teachers followed by a survey (quantitative approach) with 64 teachers	4
6. To validate the framework practicality from teachers' perspectives through focus group interviews	Think aloud interviews with 6 teachers	5
7. To identify the Human–Computer Interaction (HCI) sub-elements from the literature review		6
8. To validate the research with game developers using interviews. a. To validate the identified HCI sub-elements in a gamification context. b. To validate the gamification design elements and sub-elements identified in teachers' interviews.	An in-depth interview with 5 game developers	6
9. To identify the Gamification Design Document (GDD) components in the game design industry.	A literature search using academic papers and game design industry forums	6

Objective	Method of Investigation	Chapter Number
10. To evaluate the Ped-GDD as the research outcome with a focus group, including both teachers and game developers.	An in-depth interview with 10 teachers and 5 game developers	7
11. To critically review the research and suggest areas for future work	An overview of the research findings and limitation is discussed. Also, future work has been suggested.	8

8.4 Research contribution

The thesis contributes to the body of knowledge on promoting the collaboration between teachers and game developers in pedagogical gamification, as follows:

The review of the existing design frameworks

- According to a literature search of the Scopus database, the research area is under-explored in Saudi Arabia, which shows a context gap (as discussed in Chapter 2, Section 2.6). There is a need to support Saudi teachers in adopting new technologies to provide more interesting learning platforms.
- The research also contributes to the body of knowledge by offering a critical review of existing gamification design frameworks used in the educational context to explore current practices and find the barriers and challenges that hinder teachers' integration in the design process. The review concludes that teacher and game developers need to work in a collaborative manner.
- A comprehensive literature review was conducted to identify elements of the framework and include gamification elements in the design process.
- The primary contribution of this thesis is the development of an Agile Holistic Gamified Pedagogical Design (AH-GPD) framework. The framework would bridge the gulf between teachers and game developers by providing a communication platform. This would allow both teachers and game developers to remain focused on their area of expertise (i.e. the teachers will not be expected to delve into programming or game design technicalities). The proposed framework is meant to improve lesson design and content to be compatible with the digital era.
- This was refined by the primary research to include sub-elements for the Gamification Design (Stage 2 of the framework). As an outcome, the Pedagogical Game Design Document (Ped-GDD) has been constructed with an illustrative example provided to support its purpose of communicating the pedagogical input— as structured requirements to the game developers.

8.5 Research limitation

This research developed an agile holistic framework that supports a gamified pedagogy to promote the collaboration between teachers and game developers. The framework is based on a comprehensive literature review, and the outcome Ped-GDD evaluation indicates that the research aim and objectives are fulfilled. However, there are some limitation outlined as follows,

- As noted in Chapter 4, the survey sample size was limited to 64 and higher participants number could help limit bias in the findings. This circumstance was out of the researcher's control. Thus, the research followed up with a further in-depth think aloud interview, discussed in Chapter 5 to validate the findings.
- As discussed in Chapter 7 by teachers to add a mechanism to measure the learning outcome for students. The AH-GPD and the Ped-GDD have the learning progression presentation as one of the elements. However, teachers could be referring to including e-tests to the games to measure students' retention of the educational material. This is mentioned by Özdener (2017) and Chen *et al*. (2020) that the relation between gamified learning activity and students' test scores is not established. Therefore, adding a test function at the end of the gamified learning activity would help to identify the correlation. However, for the limited timeframe of this PhD, this was not attainable. In current gamification research, several studies also found that gamification design could foster students' performance in learning activities but have no effects on students' final exams (Hew et al., 2016; Ozdener, 2018). The results may imply a gap between gamified learning activity and the final learning outcomes. Also, this could be a result of imbalance between extrinsic and intrinsic motivation in a game design.
- Teachers' collaboration in pedagogical gamification design is the aim of this study due to their role as gatekeepers for enhanced learning experience. Therefore, including students in this case, to test and evaluate an educational game designed using the proposed Ped-GDD.

8.6 Future work

The thesis outline and discussion of research limitation identify potential development for this research. For future work, it is firstly; proposed the Learning Armoury Application to put the research findings into perspective. Secondly, it is recommended a Synergistic Digital Hub to maximise the effect on wider spectrum.

8.6.1 The Learning Armoury Application

Gamification enhances students learning experience as it is expected to keep them intrinsically engaged in school-related activities. The proposed framework is built to improve the lesson design and the content to be compatible with the digital era. Based on the presented discussion in this thesis, there is a need to support Saudi teachers in adopting new technologies to provide more interesting learning platform. For future work, this research proposes the Learning Armoury Application as a state-of-the-art collaboration platform. The use of an application instead of a website is to avoid security threats for the young audience, as suggest by one of the game developers, as discussed in Chapter 6 Section 6.7 .The application would be developed as part of e-

Government scheme to promote teachers collaboration on a national level in the KSA which will contribute to the adapting to the challenge of increased number of students in educational institutes, as discussed in Chapter 1, Section 1.2. It would contribute to the realization program of the Saudi Arabian 2030 Vision that aims to improve the educational outcomes for citizens of all ages— by teaching the skills needed to face challenges and learn emerging technologies while managing the rapid change of experience requirements. The government vision is to extend the education system for children by building an empowered citizen character (Council of Economic and Development Affairs, 2016). Initially, Learning Armoury would have three stakeholders; teachers, game developers and students. Nonetheless, it is flexible to add more stakeholders to foster further developments of the concept. The Application would allow any user to play the games, try the daily challenge and listen to podcasts without registration. However, if the player wanted to monitor their progress or would like the teacher to view their achievement, registration would be required. The full range of interface sketch is available in Appendix H. Nonetheless, three figures are presented within this chapter to demonstrate the relation between the Ped-GDD, which is the research outcome, to the application.

A. Teachers' interface

The teacher's interface has individuals' profile, a record of their participation achievement and favourite podcast provided by the ministry of education—all as part of Learning Armoury Application. As illustrated in Figure 8-1, teachers have other option of proposing a game, read feedback of the games they already proposed, follow up the class progress and participate in a teachers forum discussion.

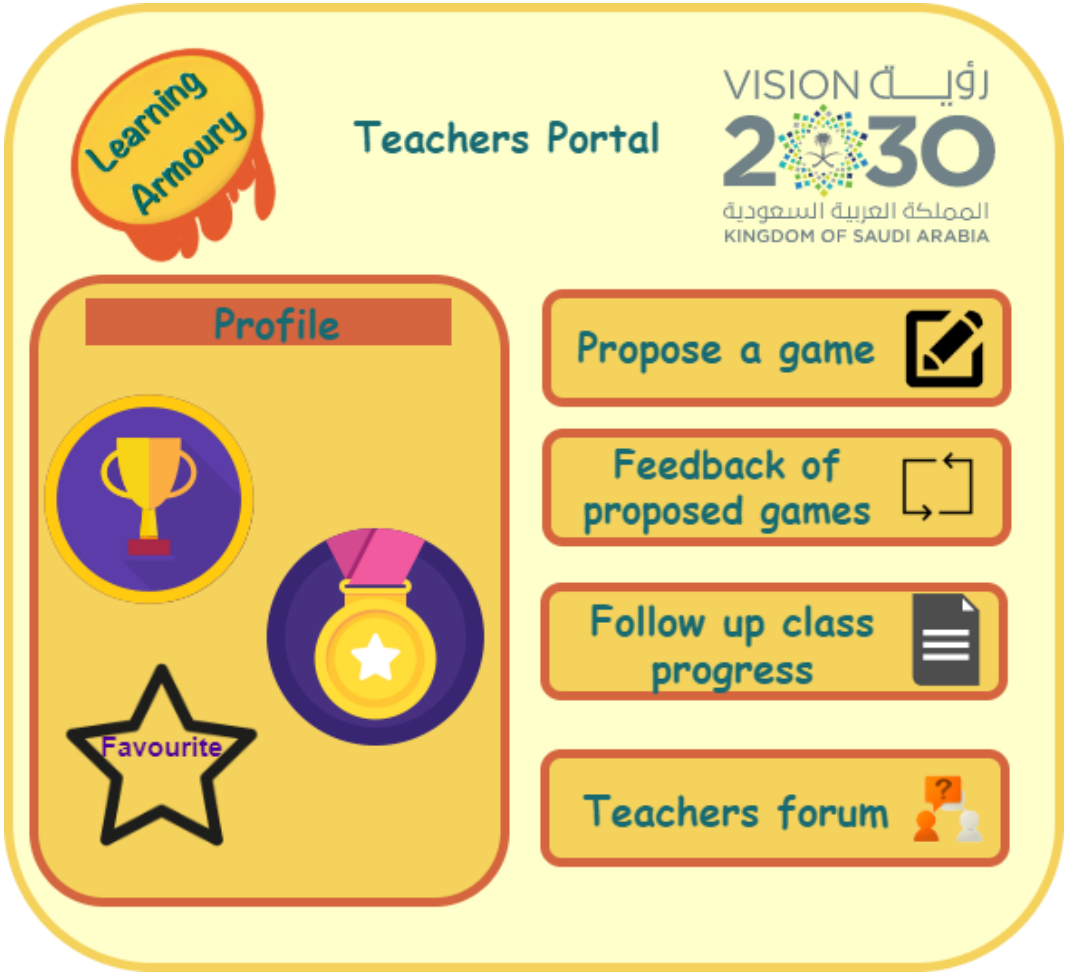


Figure 8-1. Teachers Main Interface

Teachers would be encouraged to suggest new game ideas by using the Ped-GDD elements monitoring the learning objectives, as illustrated in Figure 8-2.

Figure 8-2. Teachers Ped-GDD Elements Interface

By choosing any element the next screen would provide the sub-elements and an illustrative example, as illustrated in Figure 8-3. The analogy is that teachers would be able to see an example and replicate it according to their subject context. A final step would be to preview the game elements and upload the game proposal to Learning Armoury Application so, game developers start the next step of the design. Furthermore, teachers who have a strong interest and acts as 'champions' and would be awarded badges which provide another level of gamification to promote teachers' engagement, which would be reflected in their achievement section in their profile.

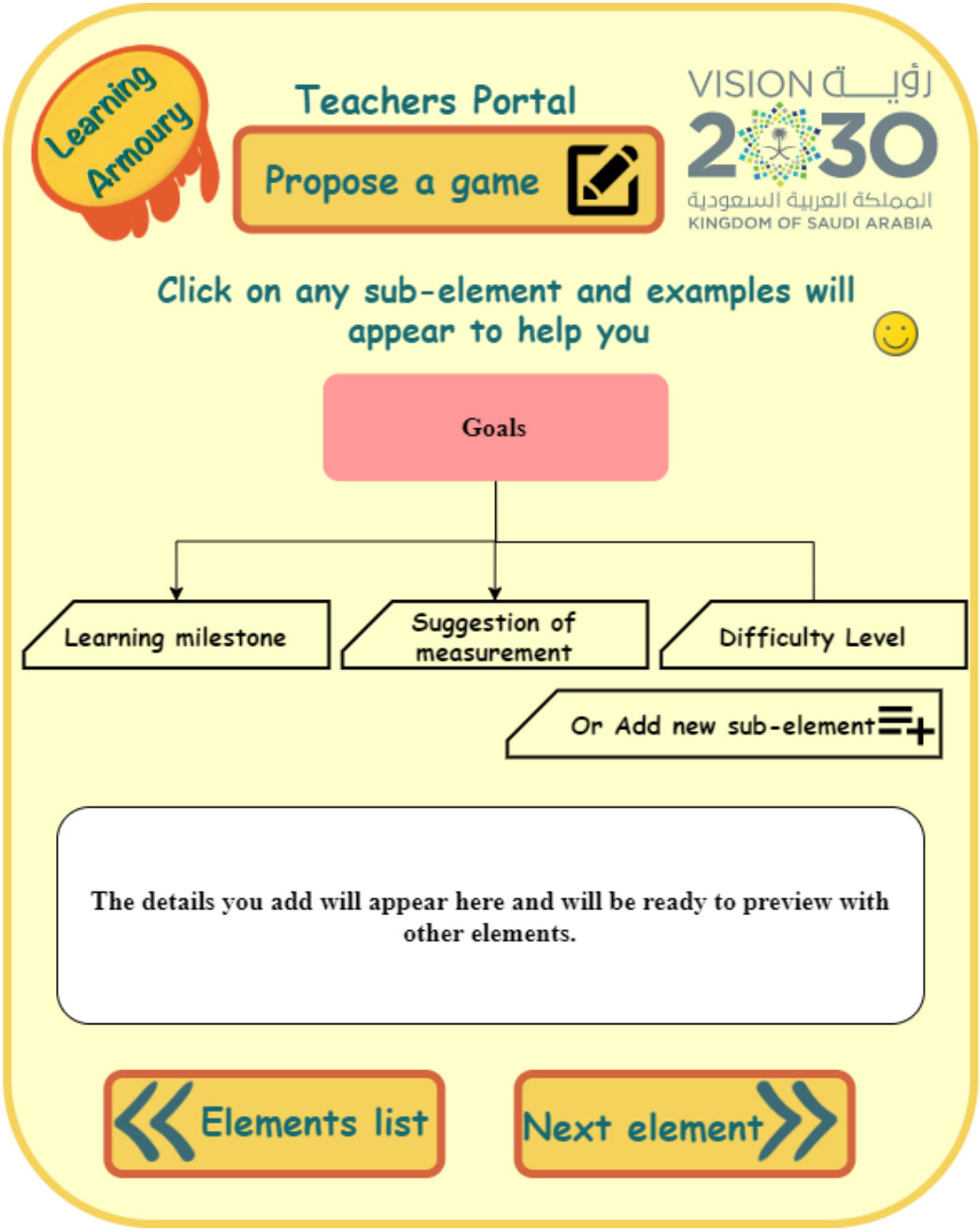


Figure 8-3 Teachers Ped-GDD Sub-elements Interface Example

B. Game developers' interface

The game developers' interface has individuals' profile, a record of their participation and achievement. Also, game developers will be able to review proposed game ideas by teachers, read feedback about games they have co-designed, game analytics reports, and review student feedback and comments. Game developers' expertise would benefit in taking an educational game suggested by teachers into an electronic form. Their collaboration with teachers would be applied through Ped-GDD elements. By choosing any element the next screen would provide the sub-elements and an illustrative example. Although, game developers will be experienced and familiar with the

terminology used in the Ped-GDD the examples would be available to ensure consistency. A final step would be to preview the gamified interface elements and upload the interface description to Learning Armoury Application.

C. Students' Interface

The young generation is passionate about technology. The update of learning/teaching tools is a necessity to match their current interest. The application will promote pupils' motivation towards learning through gamification, as discussed in Chapter 2, Section 2.4. Learning Armoury students' interaction would allow using games with no registration necessary. However, students' registration is encouraged to record individual's progress and to enable participation in class challenges with peers under teachers supervision (i.e. social interaction). Also, registration would enable students to personalise the interface, rate the game and post feedback.

D. Special educational needs students support

The Application would provide a list of podcasts to enhance the learning experience and increase the community involvement. For instance, there will be **PE game ideas** that can be used by teachers to promote physical activity during a lesson. Also, parents could incorporate PE game ideas provided into outdoor activities for the family (e.g., a simple mathematics task of counting steps in a park on a family walk). Another podcast would be for **special educational needs (inclusion) tips** and that would provide supporting material for teachers to provide inclusive learning experience. According to the Ministry of Education report, the increase in the special education needs schools between 2013— 2018 has reached 757 schools; including both public and private sectors (Ministry of Education, 2018). This indicates the increased need for support to special needs education. The podcast should include tips to customise education and learning plans, guidance on the implementation of psychological theories and success stories.

Other suggested podcasts could cover cultivating students' motivation, parents support, building hobbies and reading skills. The purpose of providing the podcast is to provide professional insight for to the community.

E. Potential stakeholders

The discussion of potential users includes parents and a government body representative. Simone *et al*. (2019) suggests that including parents as part of educational process will lead to useful cooperation experience. In the application, parents/carers interaction could include; suggesting new game ideas, evaluate children's motivation on available games. Another potential stakeholder is a government body representative. Their role would be to monitor the process and provide endorsement and financial resources based on the statistics of the application use.

8.6.2 Synergistic Digital Hub (SDH)

Another extension for this research is to create a synergistic hub that is built to analyse the data and provide information for further development plan to the Ministry of Education in KSA. The system manages the integration of different stakeholders; pupils, teachers, parents, game developers and educators expertise in the education experience, as illustrated in Figure 8-4. As research suggests that gamification is 'a modern educational approach' (Skalka & Drlik, 2018), this research suggests future work to combine the benefits of pedagogical gamification with e-Government educational initiatives to enable more extensive collaboration amongst teachers nationwide in educational software tools development. Alloghani *et al*. (2017) suggested that applying the gamification concept into the e-Government application would help to overcome the technology adoption barrier and provide feedback to enable better planning for improvements. In this research, for example, the system would be able to identify the most challenging aspects of learning for students by the most replayed or longer period of solving the task by multiple students. Also, the system will monitor the students' progression on a national level which could help identify the schools in need for supporting staff This will support the Saudi Arabian 2030 Vision and the development scheme of education for citizens from a young age (Council of Economic and Development Affairs, 2016). Such a system will ensure maximising the impact and the affiliate the effort on national level by building a national repository of Ped-GDD examples of lessons to improve resources. The repository will hold the examples of gamification elements applied to various subjects demonstrating how lessons were transformed into games.

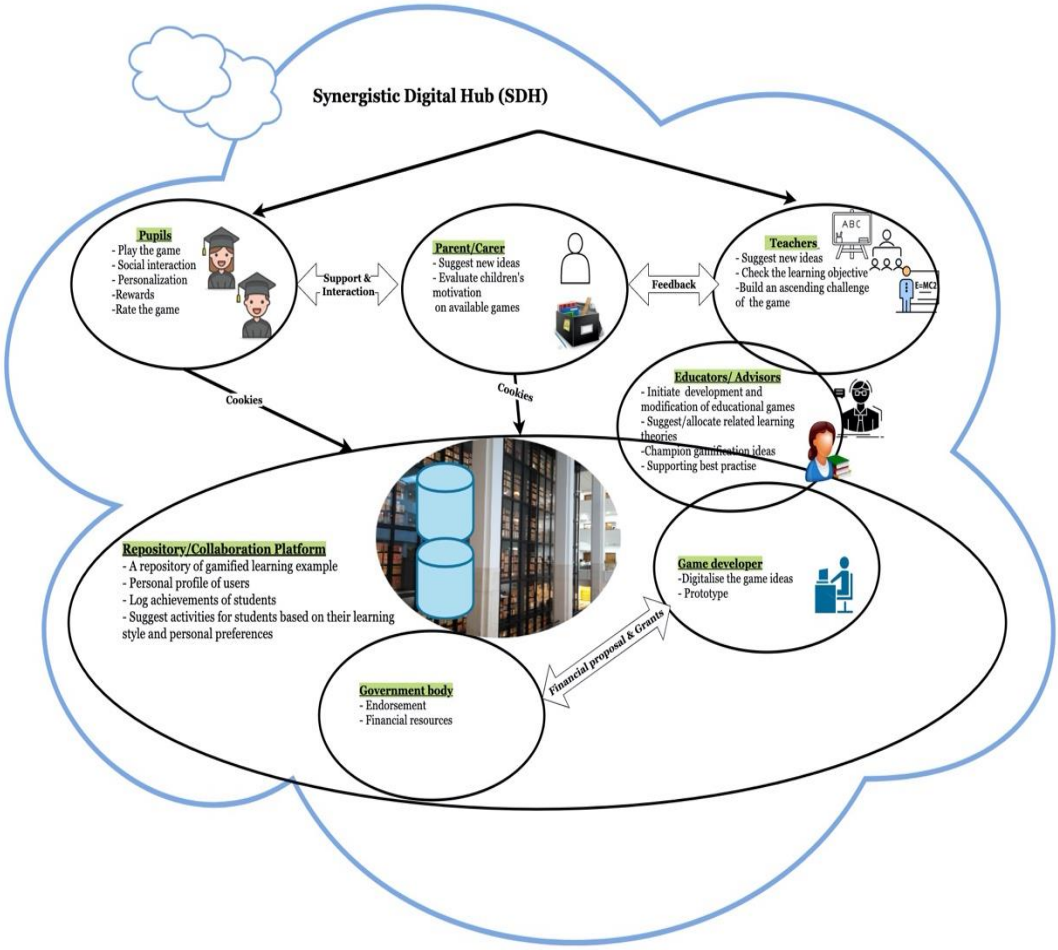


Figure 8-4. A Representation of the Proposed Synergistic Digital Hub

The roles of different stakeholders are as follow;

Repository /collaboration platform

In this SDH the platform will facilitate collaboration amongst all stakeholders; students, parents, teachers, game developers and Government bodies. The learning activities can be categorized based on learning theories stipulating the following features;

- A repository of gamified learning examples
- Personal profile of users
- Log achievements of students
- Suggest activities for students based on their learning style and personal preferences

Government body

In this SDH the following features are suggested;

- Endorsement
- Financial resources

Game Developers

Game developers' expertise would benefit in taking an educational game into an electronic form. In this SDH the following features are suggested;

- Digitalise the game ideas
- Prototype

Furthermore, game developers should be able to apply for financial initiatives required to support the electronic game design team from Government resources.

Pupils

The aim is to promote pupils' motivation towards learning using gamification. This SDH suggests the following features to be included;

- Play the game
- Social interaction
- Personalization
- Rewards
- Rate the game

Parents/carers

Including parents as part of educational process will lead to useful cooperation experience and in this SDH suggests the following features;

- Suggest new ideas
- Evaluate children's motivation on available games

Furthermore, the parents/carers should be encouraged to support and interact with their children in using the platform.

Teachers

Teachers' role has been as an important part of gamification in education in identifying goals or introducing the game to students. In this SDH suggests the following features to be included;

- Suggest new ideas
- Check the learning objective
- Build an ascending challenge of the game

Education advisor

In this SDH education advisors (these could be teachers that have a strong interest and acts as 'champions' and are seconded to this work) will work closely with teachers to fulfil the following; Initiate development and modification of educational games

- Suggest/allocate related learning theories
- Champion gamification ideas
- Supporting best practise

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Appendix A. The Ethical Approval

RESEARCH ETHICS
Full Ethical Review Form

Full ethical review must be used for research involving above minimal risk and therefore necessitating a more thorough ethical review prior to approval. Further guidance on projects which involve above minimal risk is provided within the University's Ethical Review Policy.

Relevant professional body ethical guidelines should be consulted when completing this form.

Please seek guidance from the Chair of your Faculty Research Ethics Committee if you are uncertain about any ethical issues arising from this application.

There is an obligation on the researcher and supervisor (if applicable) to bring to the attention of the Faculty Ethics Committee any issues with ethical implications not identified by this form.

PART A: TO BE COMPLETED BY RESEARCHER

Name of Researcher:	Alaa Mohammad Saggah

Student/Course Details (If Applicable)			
Student ID Number:		14025850	
Name of Supervisor(s)/Module Tutor:		Dr.Russell Campion/ Dr.Christopher McCreadie	
PhD/MPhil project:	☒		
Taught Postgraduate Project/Assignment:	☐	Award Title:	
Undergraduate Project/Assignment:	☐	Module Title:	

Project Title:	A Framework to Create Game-Based Learning Material for Children		
Expected Start Date:	28/3/2016	Expected End Date:	30/6/2019

Application Checklist Have the following documents been supplied alongside this application?	Yes	N/A
Participant information sheet(s) in language appropriate to the recipient	☒	☐
Participant consent form(s) in language appropriate to the recipient	☒	☐
Letter/s of invitation to participants in language appropriate to the recipient	☒	☐
Questionnaires (only attach questionnaires that have NOT been validated previously)	☒	☐
Health related projects only: Letters giving permission for access to participants or confirming that full LREC ethical approval is not required	☐	☒
Other relevant information (e.g. tests or product information)	☐	☒

Submission Guidance (for completion by Faculty):

1. Project Outline

Please provide a brief paragraph indicating answers to the following questions where relevant:

i) The aims and objectives of the project.
ii) Its rationale and justification.
iii) The research question or specific hypotheses to be tested.
iv) The background to the project.
v) Where the research is to be carried out.
vi) Names of other individuals or organisations involved in the project.
vii) Whether other approvals have been gained or are to be sought.

The project aims to create a new structured framework for producing game-based learning environments that starts from identifying the pupil's needs / requirements and progresses to full final evaluation of their end learning acquisition. The project has main focuses in investigating Human-Computer Interaction (HCI) principles in relation to games and learning based interfaces.

Objectives:
- Use the devised framework to create a prototype game-based learning application.
- Test the created game-based learning application with a group of pupils to investigate specifically aspects of acceptance, usability, actual learning, and identification of any framework deficiencies.
- Repair any found framework deficiencies in light of testing (detailed above).
- Identify main HCI principles associated with learning and games and represent these as followable design guidelines to be used by future developers (guidelines will be incorporated into the framework).
addressing the following research questions:

Some studies suggested that learning in a game context will improve the pupils' acquisition and retention. However, these studies need further investigation in the field of electronic games. Also, the steps used to create those games were not documented; therefore, this study will focus on modelling a game- based content with teacher's assistance as an independent aspect which will help the developer and the interface designer in the implementation later.
There had been a well-established set of HCI to help design a successful interface. However, some studies suggested that these rules may not apply to children as they represent another target with different abilities and desires. This study will investigate the established factors and their importance for game-based learning interfaces designed for children

This research will address the following research questions:

Q1: Will Game-based learning improve childrens acquisition and memory retention?
If so, what is the improvement rate?
Q2: Do HCI established aspects for adults play the same important role for childrens educational interfaces?
Q3: How do you design a game-based module as a teacher to then help a designer implement this design?

As a brief background context, the research proposed will expand on the domain of game-based learning significantly as so far there is only limited research and documentation related to children and learning effects through the inclusion of games based elements and approaches. Related to the specifics of children and Human-Computer Interaction principles there is work that exists but the majority of this is focused more towards older age ranges and adults. Where research is being pursued currently there are emerging works of interest such as Vatavu, Cramariuc, & Schipor (2015) who have researched children's touch interaction patterns, concluding their position with the development of a set of useful guidelines that illustrate many differences in use. There are of course other research works relevant, and these will equally feed into the proposed project.

As to the focus of the proposed game based prototype, this will address the educational topic of 'sustainability awareness' and will contain several sub-topics within this theme so pupils can explore and develop their learning. To test the prototype, there will be a set of defined stages employed. The intention is to get pupils to use the prototype in a classroom setting as a safe environment at their school where they already are familiar with the iPad use in class and follow a clear safety procedure. Furthermore, children will be monitored for any possible distress. If that occurs, they will be handled according by school procedures by a member of the student advisory team.

The practical testing of the prototype will be conducted in the Alfatat Girls' School in Saudi Arabia. The school principal mentioned that the classes are fitted with smartboards and use projectors and sometimes students bring iPads to the school with school office permission. Also, a few teachers have already designed games as an extra activity for children. Teachers and parents are involved in this experiment and may be contacted throughout the frameworks development when needed. Furthermore, the Saudi Arabian Cultural Bureau may sponsor this as an associated scientific trip.

The School's Principals initial agreement approval letter to confirm cooperation with the proposed research (is enclosed in Appendix G).

2. Research Procedure

Please provide a summary of the procedures that will be followed when carrying out the research project under the following headings.

a) The design of the project (including, where appropriate, issues of statistical power):

The research will utilise all relevant material and sources found at the literature review and research stage of the project to formulate a design framework. This will be created through the utilisation of existing research on educational theory, game-based learning approaches, and established HCI principles that effectively address children and their abilities to interact and learn from games artefacts.

In relation to the prototypes development background educational material (based on the Kingdom of Saudi Arabia vision 2030 - 1.2.4 Achieving Environmental Sustainability) will be utilised and modified to create a sound application to introduce children to the main principles and concepts associated to sustainability and recycling. Aspects of HCI and gaming will be designed for and implemented to create a game-based context environment that the pupil can explore and learn from.

To create the game-based learning prototype (and in doing so test and validate the framework) an experimental approach is used consisting of of four stages;

- First stage
The first stage of the frameworks development will require parents and teachers to be interviewed to determine present pupil knowledge, expectations, and obstacles for children learning about the theme topic of 'sustainability awareness'. This stage will be audio recorded for completeness and later analysis by the researcher to draw out key requirements for the game-based learning prototype.

- Second stage
Based on the data from the first stage the framework will be put into action to design and implement a 'sustainability awareness' game-based learning environment, ensuring that throughout the end product addresses key concepts and provides explanation of their importance.

- Third stage
A group of 15 pupils will use and explore the game-based learning environment created for a period of 40 minutes. The children will be asked specifically to search for certain information related to 'sustainability awareness' but not guided in a rigid way. After 40 minutes they will be asked to complete a questionnaire about the game and HCI features employed. Completion of the questionnaire will be in the presence with an adult in order to aid efficiency in completion. The pupils interaction with the environment will be videoed to later playback in order to establish and confirm levels of acceptance, and general usability. Any major concerns that are raised by the pupils will lead to

improvements being made to the games-based learning enviroment before it is used in stage four.

- Fourth stage
A new group of 30 children will be assigned randomly into two groups: a game-based learning group (15 students) and non-game-based learning group (15 students). The game-based group will use the environment in an hour session to explore and learn as much as they can on sustainability. This stage will be video recorded so the researcher can carry out later analysis.

The non-game-based learning group, will have studied the same sustainability material but will follow a traditional model of teaching with a lesson delivered by a qualified teacher. This session for consistency will last an hour.

At the end of both groups hour a rest will be given before both sets of pupils fill out a test / questionnaire with the teacher reading out the questions. Both sets of test / questionnaire papers will be analysed to establish factors of pupil interaction with the learning material, knowledge retention, and differences between knowledge acquisition between the two groups. Statistics will be applied to establish the significance of actual findings.

The results found will provide an indication on whether the framework is successful or requires further modification.

b) The procedures to be followed:

1. The full procedure to be followed by pupils is as explained in the participant information sheet(enlosed Appendix A) which will be sent to the school in advance to give time in its reading and raising of queries.
2. Consent forms will be sent to the parents earlier via an email, which will explain all experiment stages of the research.
3. Parent/teacher participants (stage one) will be asked for an interview in order to gain requirements for the game-based learning environment.
4. A 40 minute max session (stage three) will take with a group of pupils exploring the game-based learning environment. Part of this session will involve the teacher / researcher explaining what is going to happen during the session with the children.
5. At stage four 30 children will be used. 15 will learn via a traditional teaching approach and 15 via the games-based learning prototype in a one hour session. Part of the session will involve the teacher / researcher introducing the purpose and what is to go on within the session.
6. At the end of stage four all children will have a maximum of 30 minutes to complete a test / questionnaire.

c) The participation of people or animals in the project:

The first stage will be completed by the parents and teachers. The subsequent stages will be conducted with small groups of children, 15 and 30 school children (girls) respectively identified by the school based on their parents/ guardians approval.

d) How the design of the project and the procedures followed are likely to assess the research question or test the hypothesis in question or establish some significant result:

All four stages of the proposed project will help to create and strengthen the framework that has the aim to improve game-based learning application for children's usage in comparison to traditional learning. The work will measure specifically acceptance, usability, and actual learning.

e) Availability of facilities/resources/equipment to enable the project to be carried out:

For this experiment, the only resources that will be needed will be desktop computers, iPads, and standard computer software programmes, which are all already available within the proposed test school.

f) Procedures that will be followed if any adverse event occurs:

No adverse events should occur as the project is low risk in that it echoes a standard school classroom setting and scenario. There will be a teacher present at all times who will be in control of the children and class. The researcher on arrival at the School will be introduced and follow standard practices and any emergency procedures in place etc.

3. Participant Recruitment & Characteristics

Please provide clear information regarding the recruitment of participants and their appropriateness to the project:

*(**NB:** Student researchers must also ascertain from their Supervisor whether or not they require a criminal record check through the Disclosure and Barring Service (DBS) in order to enable this project to proceed. If this is the case the application must make clear whether or not it has been undertaken. Any data collection or other activities requiring this clearance must not begin until it has been obtained.)*

a) The number of participants involved in the study (including the adequacy of the sample size for both qualitative and quantitative research):

The first stage will require 20 teachers participation and 15 parents/guardians.
The third stage experiment will need 15 pupils to provide qualitative results as to their experience of exploring the game-based learning environment taking the form of feedback about acceptance and usability.
The fourth stage will require the participation of 30 pupils to measure acceptance and usability information (qualitative feedback), as well as quantitative feedback about the pupils overall learning achievement. Statistical results and significance analysis will be completed.

b) How participants will be identified, approached or recruited:

In the first stage, teachers with an experience teaching children in primary school will be recruited.
In the third and fourth stage, the process for recruiting pupils will be by parental / guardian approval for them to be added to the test groups, even if they may be from different classes but falls in the same age as the participants (as stated in 3.d).
Also, these parents are the ones who will be involved in the first stage.

c) Whether there are any inclusion or exclusion criteria, together with their justification:

The study will exclude any special needs student as they would require different / additional prepration that the researcher will not be able to provide due to timescales and access to the school and it's pupils.

d) The age range of participants; the gender balance of participants; and the participants' state of health:

The participants will all be aged 6-7 years and all in good health. Also, the school that is willing to cooperate is a girls only school; so the participants will be all girls.

e) Whether there is any inducement to participate in the study:

There are no inducements to take part in this study. Entry for the children is purely on parental / guardian approval besides that all participants involvement is entirely voluntary.

f) How participants will be informed about the right to withdraw from participation the study (and whether time limits will be established during which a participant can request for their data to be withdrawn from the study):

Participants will be informed from the outset of the research that they are able to withdraw from the study at any time, and this will be reinforced when filling in the consent form. No specific data relating to the participants will be collected and stored.

g) Whether the project involves any special groups requiring some additional justification or permission (e.g. children and young people under 18 years of age, those with a learning disability or cognitive impairment, patients, people in custody, people engaged in illegal activities (e.g. drug taking), or individuals in a dependent or unequal relationship):

This project will use as its participants children under 18 years old, being aged 6-7 years, permitted to be involved by parents / guardians.

h) Will informed consent be obtained from research participants? Yes ☒ No ☐

Please give details of who will obtain content and how this will be undertaken.

All parents / guardians will be written to and a consent form completed for either their child to partake or to exclude them from the study.

4. Information and Data

Please provide answers to the following questions regarding the handling and storage of information and data:

a) How will research data be stored (manually or electronically)?

Research data will be stored both manually and electronically.

b) How is protection given to the participants (e.g. by being made anonymous through coding and with a participant identifier code being kept separately and securely)?

Protection is given to participants by providing them with a number and referring to them as that number rather than their name in the questionnaire and any video footage. Note, the video recording facility will capture the child's face to show expression (e.g. confused, excited or disinterested as examples) but the child's name will not be displayed in the video neither written on any stored files.

c) What assurance will be given to the participant about the confidentiality of this data and the security of its storage?

No personal data will be collected or stored about the participants at all throughout the study. Only the researcher and supervision team will have access to the consent forms.

d) Is assurance given to the participant that they cannot be identified from any publication or dissemination of the results of the project?

Assurance is given to the participants that they cannot be identified from any of the results of the project by using an anonymous numbering method.

e) Who will have access to this data, and for what purposes?

Only the researcher and supervision team will have access to the consent forms.

f) How will the data be stored, for how long, and how will it be discarded?

The audio recordings (stage one), the video recordings (stage three and four) will be stored in a password secured hard drive. The questionnaire forms (stage four) will be stored in a locked desk at the research room in the university. Analysis documents will be backed up using 'OneDrive', which is provided by the university email and secured with a password. Data will need to be stored until June 2019 (up to the awarding of the PhD).

5. Risk, Harm and Other Ethical Considerations

Please provide an estimate of the perceived benefits or outcomes of the project weighed against the possible harms caused to the participants.

Please identify any potential risks or hazards that might be caused to participants or the researcher, in addition to any discomfort, distress or inconvenience to them, together with any ethical problems or considerations that the researcher considers to be important or difficult in the proposed project.

No specific issues to identify as there will be a teacher present at all times with the children and they are not being made to do or use anything different that is not already used within a standard classroom setting.Though, the participants will be monitored for any distress and will be dealt with the advice of the student counsellor who always

is a member of the school staff.
Please explain how any potential risks or hazards will be dealt with, along with any justificatory statements. This information should highlight any remaining ethical considerations and to respond to them in a way which may assist the Research Ethics Committee in arriving at some judgement upon the proposal. Please see above as there are no specific additional potential risks or hazards identified. However, any unexpected circumstances change will be dealt following the school's procedures.

6. Supporting Information

Please attach the consent form, information sheet, and questionnaire/interview questions to this application. Further guidance on the design and content of consent forms and information sheets can be found on the University's Research Ethics website.

Researcher Declaration

I undertake to carry out the project described above in accordance with ethical principles. I have completed the application in good faith. I accept that providing false information constitutes scientific fraud and will be subject to appropriate disciplinary procedures.

Signature of Researcher:		Date:	12/10/16

NB: Any departure from the protocol for this research project may mean that the ethical approval decision made by the Faculty Research Ethics Committee is no longer valid and a new ethics proposal will have to be submitted. It is the responsibility of a student researcher to discuss proposed changes to the agreed protocol with their project supervisor as soon as possible so that a revised /new ethics application can be submitted. Research based on any revised / new protocol **MUST** not proceed unless and until the protocol has ethical approval.

Next Step:

STUDENTS: Please submit this form (and supporting documentation) for consideration by your Supervisor/ Module Tutor.

STAFF: Please submit this form for consideration by the Faculty Research Ethics Committee.

PART B: TO BE COMPLETED BY SUPERVISOR/MODULE TUTOR (If Applicable)

I have examined this proposal and confirm that the rationale and methodology is appropriate and that it can proceed to the stage of ethical consideration.	☒
I have checked and approved the key documents required for this proposal (e.g. consent form, information sheet, questionnaire and interview schedule).	☒

Signature of Supervisor:	RB Campbell	Date:	12/10/16

Next Step:

Please submit this form for consideration by the Faculty Research Ethics Committee.

PART C: TO BE COMPLETED BY CHAIR OF FACULTY RESEARCH ETHICS COMMITTEE

This research proposal has been considered by the Faculty Research Ethics Committee and **RECEIVED** ethical approval.	☑
This research proposal has been considered by the Faculty Research Ethics Committee and was REFUSED ethical approval on grounds detailed below:	☐

11/11/2016

RESEARCH ETHICS

Proportionate Review Form

The Proportionate Review process may be used where the proposed research raises only minimal ethical risk. This research must: focus on minimally sensitive topics; entail minimal intrusion or disruption to others; and involve participants who would not be considered vulnerable in the context of the research.

PART A: TO BE COMPLETED BY RESEARCHER

Name of Researcher:	Alaa Mohammad Saggah

Student/Course Details (If Applicable)			
Student ID Number:		14025850	
Name of Supervisor(s)/Module Tutor:		Dr.Russell Campion/ Dr.Christopher McCreadie	
PhD/MPhil project:	☒		
Taught Postgraduate Project/Assignment:	☐	Award Title:	
Undergraduate Project/Assignment:	☐	Module Title:	

Project Title:	A Framework to Create Game-Based Learning Material for Children		
Project Outline:	The project aims to create a new structured framework for producing game-based learning environments that starts from identifying the pupil's needs / requirements and progresses to full final evaluation of their end learning acquisition. This form is for teachers in the UK to help identify the gaming aspects which are teacher related and which are designer related in the process of transferring a lesson into a game-based curriculum.		
Give a brief description of participants and procedure (methods, tests etc.)	Teachers will be filling a questionnaire (Appendix C) to determine the game design documentation and highlight gaming aspects that are teacher related in the process of transferring a lesson into a game-based curriculum. The gathered data will help the researcher to draw out key requirements for the game-based learning prototype and the framework design. Teachers are involved in this experiment and may be contacted throughout the frameworks development when needed		
Expected Start Date:	14/11/2016	Expected End Date:	16/1/2017

Relevant professional body ethical guidelines should be consulted when completing this form.

Please seek guidance from the Chair of your Faculty Research Ethics Committee if you are uncertain about any ethical issues arising from this application.

There is an obligation on the researcher and supervisor (where applicable) to bring to the attention of the Faculty Ethics Committee any issues with ethical implications not identified by this form.

Researcher Declaration

I consider that this project has no significant ethical implications requiring full ethical review by the Faculty Research Ethics Committee.	☒

I confirm that:		
1.	The research will **NOT** involve members of vulnerable groups. Vulnerable groups include but are not limited to: children and young people (under 18 years of age), those with a learning disability or cognitive impairment, patients, people in custody, people engaged in illegal activities (e.g. drug taking), or individuals in a dependent or unequal relationship.	☒
2.	The research will **NOT** involve sensitive topics. Sensitive topics include, but are not limited to: participants' sexual behaviour, their illegal or political behaviour, their experience of violence, their abuse or exploitation, their mental health, their gender or ethnic status. The research must not involve groups where permission of a gatekeeper is normally required for initial access to members, for example, ethnic or cultural groups, native peoples or indigenous communities.	☒
3.	The research will **NOT** deliberately mislead participants in any way.	☒
4.	The research will **NOT** involve access to records of personal or confidential information, including genetic or other biological information, concerning identifiable individuals.	☒
5.	The research will **NOT** induce psychological stress, anxiety or humiliation, cause more than minimal pain, or involve intrusive interventions. This includes, but is not limited to: the administration of drugs or other substances, vigorous physical exercise, or techniques such as hypnotherapy which may cause participants to reveal information which could cause concern, in the course of their everyday life.	☒
6.	The research **WILL** be conducted with participants' full and informed consent at the time the study is carried out: • The main procedure will be explained to participants in advance, so that they are informed about what to expect. ☒ • Participants will be told their involvement in the research is voluntary. ☒ • Written consent will be obtained from participants. *(This is not required for self-completion questionnaires as submission of the completed questionnaire implies consent to participate).* ☒ • Participants will be informed about how they may withdraw from the research at any time and for any reason. ☒ • For questionnaires and interviews: Participants will be given the option of omitting questions they do not want to answer. ☒ • Participants will be told that their data will be treated with full confidentiality and that, if published, every effort will be made to ensure it will not be identifiable as theirs. ☒ • Participants will be given the opportunity to be debriefed i.e. to find out more about the study and its results. ☒	☒ N/A ☐

If you are unable to confirm any of the above statements, please complete a **Full Ethical Review Form**. If the research will include participants that are **patients,** please complete the Independent Peer Review process.

Supporting Documentation

All key documents e.g. consent form, information sheet, questionnaire/interview schedule are appended to this application.	☒

Signature of Researcher:		Date:	7/11/2016

NB: If the research departs from the protocol which provides the basis for this proportionate review, then further review will be required and the applicant and supervisor(s) should consider whether or not the proportionate review remains appropriate. If it is no longer appropriate a full ethical review form **MUST** be submitted for consideration by the Faculty Research Ethics Committee.

Next Step:

STUDENTS: Please submit this form (and supporting documentation) for consideration by your Supervisor/ Module Tutor.

STAFF: Please forward this form to the Chair of Faculty Research Ethics Committee who will arrange for it to be considered by an independent member of the Faculty Research Ethics Committee.

PART B: TO BE COMPLETED BY SUPERVISOR/MODULE TUTOR (If Applicable)

I consider that this project has no significant ethical implications requiring full ethical review by the Faculty Research Ethics Committee.	☒
I have checked and approved the key documents required for this proposal (e.g. consent form, information sheet, questionnaire, interview schedule).	☒

Signature of Supervisor:	RB Campi	Date:	7/11/16

Next Step: Please forward this form to the Chair of Faculty Research Ethics Committee who will arrange for it to be considered by an independent member of the Faculty Research Ethics Committee, having no direct connection with the researcher or his/her programme of study.

PART C: TO BE COMPLETED BY FACULTY RESEARCH ETHICS COMMITTEE MEMBER

This research proposal has been considered using agreed University Procedures and is now approved. **Or** This research proposal has not been approved due to the reasons given below.	☑ ☒

Name of Reviewer:	Elhadj Bawkheli/a	Date:	11/11/2016
Signature:	E. [illegible]		

PROPORTIONATE REVIEW APPROVAL FEEDBACK

Researcher Name:	Alaa Saggah
Title of Study:	A novel gamified learning framework
Status of approval:	Approved

Thank you for forwarding the amendments requested by the Ethics Panel.

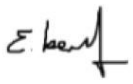
Action now needed:

Your project proposal has been approved by the Ethics Panel and you may commence the implementation phase of your study. You should do so in conjunction with your supervisor.

You should note that any divergence from the approved procedures and research method will invalidate any insurance and liability cover from the University. You should, therefore, notify the Panel of any significant divergence from this approved proposal.

When your study is complete, please send the ethics committee an end of study report. A template can be found on the ethics BlackBoard site.

Signed: Prof. Elhadj Benkhelifa **Date: 13/12/2018**



Chair of the Computing and Digital Technologies Ethics Panel

Appendix B. A Sample of The Literature Review Analysis Sheet

Author	Year	Title	note	Design framework/tool	Teachers' role
Palomo-Duarte et al	2014	Foreign language learning using a gamificated app to support peer-assessment			participated in building the game content (no steps or process)
Melero et al	2015	Group-based mobile learning: Do group size and sharing mobile devices matter?			was summarised in a table
Weitze	2015	Learning and motivational processes when students design curriculum-based digital learning games	writer of Paper3	smiley model and another one	
Clarke et al	2016	SimAULA: Creating higher-level gamification through adoption of a learning-objective to game-objective mapping	Gamified sys used to trai teachers NOT BUILD with teachers' input		
Reng & Schoenau-Fog	2016	The game enhanced learning model: Mapping game-based learning for educators	suppports the novelty "Failing to find a simple model that shows the different types of game-based learning structured to aid new teachers and school leaders, we decided to introduce a new model. "		
Schulz et al.	2016	Ethical issues of gamified ICT tools for higher education	This paper presents ethical considerations as to how to properly motivate teachers to adopt new technology in their teaching practices.		
Kermek et al.	2016	Preparation of a hybrid e-learning course for gamification		adding elements on e-learning systems and no framework/tool	Not discussed
Baldeón	2016	LEGA: A LEarner-centered GAmification design fra mework	Learning styles discussion		Not discussed
Markopoulo	2016	Gamifying e-learning as a means		adding elements on	
de Oliveira & Santos	2016	PBLMaestro: A virtual learning environment for the implementation of problem-based learning approach in			

Appendix C. A Thorough List of the Gamification Elements References

Gamification elements	References list
1. Game idea: the theme and storyline	(Kapp, 2012), (Melero et al., 2013), (Villagrasa & Duran, 2013), (Botha et al., 2014), (Mystakidis et al., 2014) , (Botha & Herselman, 2015), (Lameras & Moumoutzis, 2015), (Senderek et al., 2015) , (Chou, 2016), (González et al., 2016), (Goshevski et al., 2017), (Sailer et al., 2017), (Aldemir et al., 2018) (Mystakidis & Berki, 2018)
2. Goals: set number of tasks for pupils to achieve	(Sweetser & Wyeth, 2005), (Kapp, 2012), (Gordillo et al., 2013) , (Browne et al., 2014), (Botha & Herselman, 2015), (Lameras & Moumoutzis, 2015) (Toda et al., 2015), (González et al., 2016), (García et al., 2017), (Landers et al., 2017), (Özdener, 2017), (Aldemir et al., 2018)
3. Rules: set main rules for the game	(Kapp, 2012), (Kermek et al., 2016), (García et al., 2017), (Goshevski et al., 2017)
4. Time: allocating each task a session duration	(Kapp, 2012), (Ašeriškis & Damaševičius, 2014), (Browne et al., 2014), (Faghihi et al., 2014), (Toda et al., 2015), (González et al., 2016)
5. Level: structured levels to provide the player with additional interest to succeed each level and move forward	(Villagrasa & Duran, 2013), (Melero et al., 2013), (Browne et al., 2014), (Melero et al., 2015), (Pedreira et al., 2015), (Senderek et al., 2015) , (Toda et al., 2015), (Baldeón et al., 2016), (González et al., 2016), (Halloluwa et al., 2016), (Heryadi & Muliamin, 2016), (Markopoulos et al., 2016), (Nunes et al., 2016), (García et al., 2017), (Goshevski et al., 2017), (Landers et al., 2017), (Pineda-Corcho & Moreno-Cadavid, 2017), (Steinberger et al., 2017), (Aldemir et al., 2018) , (Dichev et al., 2018), (Lo & Hew, 2018)err
6. Number of players	(Stanley, 2014)
7. Objects to be added	(Sharples et al., 2005), (Noran & Ovidiu, 2016) (Börjesson et al., 2015), Andrade and Law (2018).
8. The multimedia elements choices, such as photo, video,	(Kapp, 2012), (Senderek et al., 2015), (García et al., 2017), (Mayer, 2017), (Fitz-Walter et al., 2017)

audio, text, and animation, etc.	
9. Controls: user input methods, such as choosing touch screen or voice command, etc. for output and pupil feedback	(Sweetser & Wyeth, 2005), (Heryadi & Muliamin, 2016), (Thorpe et al., 2011)
10. Add excitement in certain points of the game. Such as, adding a timing rule for bonus levels	(Sweetser & Wyeth, 2005), (Kapp, 2012), (Chou, 2016), (Baldeón et al., 2016) , (Nunes et al., 2016),
11. The social engagement: To plan conflict, competition or cooperation with other players as one team or as competitors	(Kapp, 2012) ,(Simões et al., 2013b), (Villagrasa & Duran, 2013) , (Pedreira et al., 2015) , (Chou, 2016), (de Oliveira & Santos, 2016), (González et al., 2016), (Nunes et al., 2016), (Maican et al., 2016), (Markopoulos et al., 2016) , (Tenório et al., 2016), (Fitz-Walter et al., 2017), (Goshevski et al., 2017), (Özdener, 2017), (Sailer et al., 2017), (Aldemir et al., 2018), (Lo & Hew, 2018), (Toda et al., 2019)
12. Reward structure: useful to motivate the players. Such as points system, badges, or top player list, leaderboard	(Kapp, 2012), (Simões et al., 2013b), (Villagrasa & Duran, 2013), (Ašeriškis & Damaševičius, 2014), (Botha et al., 2014)(Botha et al., 2014)(Botha et al., 2014)(Botha et al., 2014)(Botha et al., 2014)(Botha et al., 2014)(Botha et al., 2014)(Botha et al., 2014)(Botha et al., 2014), (Faghihi et al., 2014), (Lameras & Moumoutzis, 2015), (Melero et al., 2015), (Naik & Kamat, 2015), (Pedreira et al., 2015), (Toda et al., 2015), (Chou, 2016), (de Oliveira & Santos, 2016), (da Rocha Seixas et al., 2016) , (González et al., 2016), (Halloluwa et al., 2016), (Heryadi & Muliamin, 2016), (Nunes et al., 2016), (Maican et al., 2016), (Markopoulos et al., 2016) , (Sanmugam et al., 2016), (Tenório et al., 2016), (Çakıroğlu et al., 2017), (Fitz-Walter et al., 2017), (Goshevski et al., 2017) ,(Kintsakis & Rangoussi, 2017), (Landers & Armstrong, 2017), (Özdener, 2017), (Peng et al., 2017) (Pineda-Corcho & Moreno-Cadavid, 2017), (Sailer et al., 2017), (Simionescu

	et al., 2017), (Steinberger et al., 2017), (Aldemir et al., 2018), (Lo & Hew, 2018), (Toda et al., 2019),
13. Replay option: Allowing the player to repeat the game starting from the last successful level	(Kapp, 2012), (Botha et al., 2014), (Botha & Herselman, 2015) , (Chou, 2016), (Noran & Ovidiu, 2016), (Goshevski et al., 2017)
14. Learning progression: representing the actual student acquisition throughout the game	(Dodero et al., 2014) , (Botha & Herselman, 2015) , (Naik & Kamat, 2015), (Lameras & Moumoutzis, 2015), (Toda et al., 2015), , (de Oliveira & Santos, 2016), (Markopoulos et al., 2016), (Fitz-Walter et al., 2017), (García et al., 2017), (Goshevski et al., 2017), (Peng et al., 2017), (Sailer et al., 2017), (Steinberger et al., 2017), (Aldemir et al., 2018), (Lo & Hew, 2018)

Appendix D.

Appendix D.1: The Pilot Interview Questions

1. How many years have you been teaching?
    - Less than a year
    - 1-5 years
    - 6-10 years
    - 11-15 years
    - More than 15 years

2. What subject(s) do you teach?

    ……

3. Are you using electronic games with students such as web games, iPad applications etc.?
    - Yes
    - No

    (If you answered question 3 with “Yes” please proceed otherwise move to question number 7.)

4. How long have been using electronic games?
    - Less than a year
    - More than one year, please specify ……..

5. What platform are you using?
    - iPad applications
    - Computer games
    - Online games
    - Others, please specify …….

6. What is the purpose of using electronic games? (you can choose more than one answer)
    - Main delivery
    - Enhancing the students experience
    - Extra practice
    - As a rewards mechanism

7. The following aspects are used to design games. How relative are they to the teacher or designer in the process of transferring a lesson curriculum into a game-based curriculum to document an interface design?

On a scale of 1-5 how relative are the following game design issues:

1. Only teacher related
2. Somewhat teacher related
3. Both equally
4. Somewhat interface designer related
5. Only interface designer related

Aspects of games	Only teacher related	Somewhat teacher related	Both equally	Somewhat interface designer related	Only interface designer related
7.1. Game idea: the theme and storyline					
7.2. Goals: set a number of tasks for pupils to achieve					
7.3. Rules: set main rules for the game					
7.4. Time: allocating each task a session duration					
7.5. Level: structured levels to provide the player with additional interest to succeed each level and move forward					
7.6. Number of players					
7.7. Specify the objects to be added					
7.8. Choosing the multimedia elements such as photo, video, audio, text, and animation etc.					

7.9. Controls: user input method, such as choosing touch screen or voice command etc. for output and pupil feedback					
7.10. Add excitement in certain points of the game. Such as, adding a timing rule for bonus levels					
7.11. The social engagement: To plan conflict, competition or cooperation with other players as one team or as competitors					
7.12. Reward structure: useful to motivate the players. Such as, points system, badges, or top player list					
7.13. Replay option: Allowing the player to repeat the game starting from the last successful level					
7.14. Learning progression: representing the actual student acquisition throughout the game					

Appendix D.2. The Teachers Survey Questions

1. ID
2. Gender
    - 1 Male
    - 2 Female
3. School name
4. Is it Public or Private school?
    - Public.
    - Private.
5. What is the school level you are teaching currently?
    - Key Stage 1
    - Key Stage 2
6. How many years have you been teaching in general?

7. What subjects do you teach?

8. Are you using electronic games with students such as online computer games, iPad applications, etc.?

- Yes
- No

9. How long have been using electronic games?

0—10

10. What platform are you using?
    - iPad applications
    - Computers
    - Interactive whiteboard
11. Have you found any guidelines in the platform?

- Yes
- Did not need any
- No

12. Have you tried to make an electronic game yourself?
    - Yes
    - No
13. What is the program/application you used
14. Have you find any guidelines addressed to help teachers design games?
    - Yes
    - No
    - If yes, please provide details. Such as, what are the guidelines and where have you found it.
15. What is the purpose of using electronic games? (you can choose more than one answer)
    - Main delivery
    - Extra practice to enhance students' experience
    - Rewards mechanism
    - Homework
    - Others
    - If you choose "other" in the previous question, specify
16. How far do you think teachers should be involved in the learning game design?
17. The following aspects are used to design games. How relative are they to the teacher or designer in the process of transferring a lesson curriculum into a game-based curriculum to document an interface design?

1 Teacher 2 GD 3 Both	
Game idea: the theme and storyline	
Goals: set number of tasks for pupils to achieve	
Rules: set main rules for the game	
Time: allocating each task a session duration	
Level: structured levels to provide the player with additional interest to succeed each level and move forward	
Number of players	
The multimedia elements choices, such as photo, video, audio, text, and animation, etc.	
Controls: user input methods, such as choosing touch screen or voice command, etc. for output and pupil feedback	
Add excitement in certain points of the game. Such as, adding a timing rule for bonus levels	
The social engagement: To plan conflict, competition or cooperation with other players as one team or as competitors	
Reward structure: useful to motivate the players. Such as points system, badges, or top player list	
Replay option: Allowing the player to repeat the game starting from the last successful level	
Learning progression: representing the actual student acquisition throughout the game	

18. If you have any comment on educational games use at your school, please add it here.
19. If you do not mind the researcher contacting you (if they needed further information), please write your email.

Appendix E.

Appendix E.1.The Pilot Interview Questions

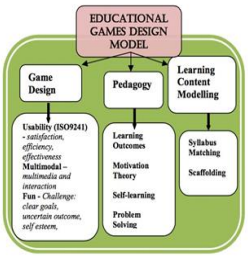
Participant No.

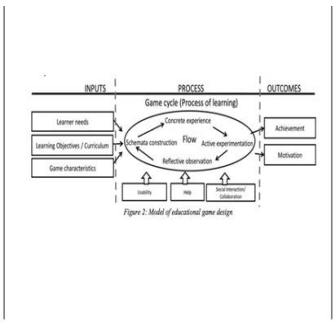
1. Gender
2. Is it Public or Private school?
3. What is the school level you are teaching currently? (1 Key stage 1/2 Key stage 2)
4. How many years have you been teaching in general?
5. What subjects do you teach?
6. Are you using electronic games with students such as online computer games, iPad applications, etc.? (Yes/ No)
7. How long have been using electronic games?
8. What platform are you using? (iPad applications/Computers/Interactive whiteboard)
9. Have you found any guidelines in the platform?
10. Have you tried to make an electronic game yourself? (Yes/ No)
11. What is the program/application you used?
12. Have you found any guidelines addressed to help teachers design games? (Yes/ No)
13. If yes, please provide details. Such as, what are the guidelines and where have you found it.
14. What is the purpose of using electronic games? (you can choose more than one answer)
    - Main delivery
    - Extra practice to enhance students' experience
    - Rewards mechanism
    - Homework
    - Others. Please, explain
15. How far do you think teachers should be involved in the learning game design?
16. The following aspects are used to design games. How relative are they to the teacher or designer in the process of transferring a lesson curriculum into a game-based curriculum to document an interface design?

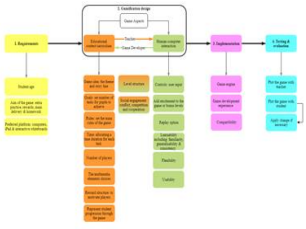
1 Teacher 2 GD 3 Both

1. Game idea: the theme and storyline	
2. Goals: set number of tasks for pupils to achieve	
3. Rules: set main rules for the game	
4. Time: allocating each task a session duration	
5. Level: structured levels to provide the player with additional interest to succeed each level and move forward	
6. Number of players	
7. The multimedia elements choices, such as photo, video, audio, text, and animation, etc.	
8. Controls: user input methods, such as choosing touch screen or voice command, etc. for output and pupil feedback	
9. Add excitement in certain points of the game. Such as, adding a timing rule for bonus levels	
10. The social engagement: To plan conflict, competition or cooperation with other players as one team or as competitors	
11. Reward structure: useful to motivate the players. Such as points system, badges, or top player list	
12. Replay option: Allowing the player to repeat the game starting from the last successful level	
13. Learning progression: representing the actual student acquisition throughout the game	

17. The following models are used for educational game design. which one would you use? And why?







18. Using the model, you chose earlier, identify game requirements for a lesson of your choice.
19. Do you have any comment on educational games use at your school?

Appendix E.2. The Think Aloud Interview Questions

Participant No.

1. Gender
2. Is it Public or Private school?
3. What is the school level you are teaching currently? (1 Key stage 1/2 Key stage 2)
4. How many years have you been teaching in general?
5. What subjects do you teach?
6. Are you using electronic games with students such as online computer games, iPad applications, etc.? (Yes/ No)
7. How long have been using electronic games?
8. What platform are you using? (iPad applications/Computers/Interactive whiteboard)
9. Have you found any guidelines in the platform?
10. Have you tried to make an electronic game yourself? (Yes/ No)
11. What is the program/application you used?
12. Have you found any guidelines addressed to help teachers design games? (Yes/ No)
13. If yes, please provide details. Such as, what are the guidelines and where have you found it.
14. What is the purpose of using electronic games? (you can choose more than one answer)
    - Main delivery
    - Extra practice to enhance students' experience
    - Rewards mechanism
    - Homework
    - Others. Please, explain
15. How far do you think teachers should be involved in the learning game design?
16. The following aspects are used to design games. How relative are they to the teacher or designer in the process of transferring a lesson curriculum into a game-based curriculum to document an interface design?

1 Teacher 2 GD 3 Both	
Game idea: the theme and storyline	
Goals: set number of tasks for pupils to achieve	
Rules: set main rules for the game	
Time: allocating each task a session duration	
Level: structured levels to provide the player with additional interest to succeed each level and move forward	
Number of players	
The multimedia elements choices, such as photo, video, audio, text, and animation, etc.	
Controls: user input methods, such as choosing touch screen or voice command, etc. for output and pupil feedback	
Add excitement in certain points of the game. Such as, adding a timing rule for bonus levels	
The social engagement: To plan conflict, competition or cooperation with other players as one team or as competitors	
Reward structure: useful to motivate the players. Such as points system, badges, or top player list	
Replay option: Allowing the player to repeat the game starting from the last successful level	
Learning progression: representing the actual student acquisition throughout the game	

17. Using the gamification list provided, identify game requirements for a lesson of your choice and preferably draw a sketch of the game interface. (the list was printed for the participants)
18. Do you have any comment on educational games use at your school?

Appendix E.3. An Extended Version of Table 5-4. Gamification Elements in the Theoretical Categorisation and Practical Utilisation

Gamification elements	**In-theory** categorisation (Code 1) -Relates to No of participants			**In practice** utilisation during task design (Code 2)-Relates to No of participants		
	Teacher-driven task	**Game developer's task**	**Shared task**	**Confidently utilised**	**Need guidance**	**Not utilised**
1. Goals	5 (P1, P2, P3, P4, P6)	0	1 (P5)	5 (P1, P2, P3, P4, P5)	1 (P6)	--
2. Level	4 (P1, P2, P4, P6)	1 (P3)	1 (P5)	4 (P2, P3, P5, P6)	1 (P1)	1 (P4)
3. Multimedia choices	4 (P1, P2, P4, P6)	1 (P3)	1 (P5)	3 (P2, P3, P6)	3 (P1, P4, P5)	--
4. Timing	3 (P1, P3, P5)	0	3 (P2, P4, P6)	5 (P1, P2, P3, P5, P6)	1 (P4)	--
5. Social engagement	3 (P1, P3, P4)	0	3 (P2, P5, P6)	4 (P3, P4, P5, P6)	1 (P1)	1 (P2)
6. Number of players	3 (P1, P3, P5)	0	3 (P2, P4, P6)	4 (P1, P3, P5, P6)	1 (P4)	1 (P2)
7. Reward structure	5 (P1, P3, P4, P5, P6)	1 (P2)	0	2 (P3, P6)	--	4 (P1, P2, P4, P5)
8. Replay option	4 (P1, P3, P5, P6)	0	2 (P2, P5)	2 (P3, P4)	1 (P2)	3 (P1, P5, P6)
9. Controls	3 (P1, P2, P4)	1 (P5)	2 (P3, P6)	1 (P4)	5 (P1, P2, P3, P5, P6)	--
10. Storyline	4 (P1, P4, P5, P6)	0	2 (P2, P3)	1 (P3)	2 (P1, P5)	3 (P2, P4, P6)
11. Added excitement	3 (P2, P5, P6)	2 (P3, P4)	1 (P1)	1 (P3)	--	5 (P1, P2, P4, P5, P6)
12. Rules	2 (P3, P6)	3 (P2, P4, P5)	1 (P1)	1 (P4)	2 (P3, P6)	3 (P1, P2, P5)
13. Learning progression presentation	3 (P1, P3, P5)	2 (P2, P4)	1 (P6)	--		6 (P1, P2, P3, P4, P5, P6)

Appendix E.4. The Full Analysis of The Gamification Elements.

Theme 1: Individual gamification elements

The colour coding of the individual elements is as follows: coloured background text highlights the justification of the elements' categorisation; italicised text in blue and green highlights the addition of the 'sub-elements' to the AH-GPD framework.

Sub-theme 1: Commonly used pedagogical elements of gamification

Element 1. Goals

The goals set as a gamification element is discussed in detail in Chapter 3, Section 3.5. Kapp (2012) distinguishes a game from a play by a goal; a game is defined by the goals that provide a milestone to reach. According to García *et al*. (2017), the perception of goals is a measurable outcome of the game. Özdener (2017) referred to the goals as 'challenges', meaning tasks to be accomplished by students. In this research, goals represent pedagogical objectives that are transformed into milestones to be reached. The significance of players accomplishing the milestones is to promote motivation (Landers et al., 2017).

Code 1: In the initial categorisation part of the interview, *five participants perceived goals as a teacher-driven task*, and only *one participant* chose to keep the element as *a shared task*. The in-theory categorisation reflects the importance of goals from a pedagogical perspective.

Code 2: During the task design, *five teachers were able to apply the element confidently,* as illustrated in Table 5-3. P2, P3 and P4 wrote the goals as bullet points next to the interface sketch, while P1 narrated them to the researcher. P5 and P6 used writing at the beginning and for narrating more goals later during the design. As the teachers worked through the sketch, sometimes they found a new goal(s) to be added, which suggests that identifying goals as an element has an iterative nature. *Codes 1 and 2 show consistency in demonstrating the goals pedagogical relatedness*. All participants were able to identify game goals. Five participants utilised the element confidently, displaying a significant level of understanding, while one participant needed guidance. The confident utilisation was identifying the lesson's learning objectives. The following comparison between a confident utilisation by P2 and a need for guidance by P6 is provided for illustration.

P2 showed confident utilisation, while P6 showed an understanding of high-level goals but needed guidance applying the element. P2's utilisation confidence was demonstrated in identifying goals for the following example English-language lesson: P2 highlighted the students' ability to identify the 'letter's sound, the letter's writing technique, recognising the letter in few words' as measurable goals related to the milestones of the game. In contrast, P6's utilisation involved identifying four goals; for example, P6 stated that it is necessary 'to provide the educational content for the student by dividing the scientific material into small chunks, so they acquire information easily'. In this participant's case, the goals were generic and unmeasurable. The first utilisation, by

P2, was in accordance with the goals defined by (Kapp, 2012), (García et al., 2017) and (Landers et al., 2017), suggesting clear, measurable outcomes. Conversely, P6's utilisation showed an understanding of the generic concept of goals, where P6 explained that goals are 'small chunks' necessary to set requirements and measure the expected outcomes of the game. However, P6 did not identify any goals, which clearly demonstrated the need for guidance to identify the lesson's learning objectives as game goals. P6's perception was in line with García et al. (2017), who recognised goals as a measurable outcome of the game. Therefore, the framework should illustrate the standard two-fold mechanism in identifying goals—milestones and suggestions of measurement.

Code 3: Interestingly, *setting goals is one of the most utilised elements* in task design and is connected to levels as consequence elements in the design. This was discussed by P4, who stated, *'Defining the learning goal and ordering objectives from the easiest to the most difficult is part of the teacher's lesson plan'* during the initial in-theory categorisation. P4's comment suggests *a similarity between identifying the lesson's learning objectives and identifying game goals, which is supported by other participants.* For example, P1 stated, 'as it is a learning game, the goals will be lesson-learning objectives'.

In summary, the confidence and consistency in setting a goal(s) as a gamification element, in-theory and in-practice, foremost emphasises a high pedagogical relation of goals, which suggests that goals should be identified by teachers, or at least with teachers' input. This finding is in line with Lameras and Moumoutzis's (2015) work, which emphasises the importance of having a teacher's input in goal setting.

Participants' utilisation suggests a dynamic nature of the element, requiring flexibility. Most of the participants started the task design by identifying goals. However, some participants wanted to add additional goals during the development process. This suggests *that identifying goals may be an iterative process, and the framework should enable teachers to add new goals at different points in the design process*.

To ensure the consistency of the framework, outcomes guidance was provided to participants to help them identify the goals. This research highlights the standard *two-fold mechanism in identifying goals—milestones and suggestion of measurement*. Furthermore, the goal-stating format as suggesting milestones and adding suggestions for measuring mechanisms involved, for example, offering a *suggestion list of quantifiable methods to measure them, hence, providing guidance with minimal technicality involved.*

Although the literature has suggested a relationship between goals and rewards—such as badges (Browne et al., 2014; Botha & Herselman, 2015) or points (González et al., 2016)—the relationship was not recognised by the participants in this study.

Element 2. Levels

In game design, identifying different levels is to provide sub-goals for the game (González et al., 2016). The game should be structured to provide the player with additional interest to succeed and move forward. The level has been referred to differently in literature, i.e., as 'quests' by (Villagrasa & Duran, 2013), 'sub-goals' by (González et al., 2016) and 'challenges' by (Goshevski et al., 2017). Some references suggest an increase of difficulty as the games progress (Pedreira et al., 2015; Halloluwa et al., 2016; Markopoulos et al., 2016; Landers et al., 2017; Steinberger et al., 2017. Alternatively, others suggest none (Toda et al., 2015; González et al., 2016; Heryadi & Muliamin, 2016; García et al., 2017). In this research, the level meant to provide smaller learning objectives for students, and in the discussion of this element is provided in Chapter 3, Section 3.5. The significance is to motivate students to progress to the next level, which holds a different learning objective (Landers et al., 2017).

(Code 1) In the initial categorisation part of the interview, *three participants identified this task as a teacher-driven*, while *one* perceived it *as a shared task*. P3 was the only participant categorised levels as a game developer's task. However, P3's comment implies the opposite, "*But the game developer will follow the goals written by me which are ordered from easy to difficult*" (P3). During the discussion, P1 misunderstood the concept saying, "to identify students' abilities" (P1). P1's comment implies that the students' level will be assessed through the game, while the levels concept in this research is for the teacher to divide the learning objectives of the game.

Another shared suggestion among three participants, *P2, P3 and P4, is the ascending level of difficulty*. For example, P3's comment shown in the previous paragraph. P2 said, "Writing objectives in the game's chronological order, also*, the sequence from easy to more challenging*". Moreover, P4 stated, "I usually arrange *the lesson objectives from the easiest to the most difficult,* to avoid student's frustration by addressing the most difficult objectives earlier". All are suggesting an ascending nature in the difficulty level of the learning objectives. Furthermore, P4 pointed out that addressing the challenging objectives earlier might lead to frustration and despair. For an educational game, the sense of challenge from an early stage at the game is not recommended by the participants in this research.

(Code 2) During the task design, four participants set the learning objectives in ascending order. Noticeably, participants demonstrate an intersection between goals and level, i.e., all participants who utilised the goals to their design, either confidently or needed guidance, addressed the learning objectives in sequence from the easiest to the most difficult. A noticeable relation is between goals and levels is demonstrated in three participants' utilisation. *The design flow by P2, P 3and P5*, suggested a sequence of gaols followed by setting levels, further discussion is in **Theme 6**. The only participant who did not apply level is P4, due to the simplicity of the game genre, which

in P4 case was a puzzle, where the aim of the game chosen by the participant is an introduction, which implies no need for levels.

Summary, the persistent utilisation of *defining levels by the participants, in-theory and in-practice, emphasises the importance of defining levels from a pedagogical perspective*. Moreover, the level-defining task is highly relevant for teachers. Participants' utilisation during the task design manifested as a relation and sequence between goals and levels. The goals were addressed first and were broken down into small learning objectives that ascended with the challenge level. Therefore, the framework *merged levels within goals and allowed the facilitation of the ascending nature of the learning objectives.*

Element 3. The multimedia choice

The multimedia choice in learning or gamified environment is an important decision. Kapp (2012) and García *et al*. (2017) referred to the element as 'Aesthetics' and connected this with providing a creative interface design that appeals to users. Also, using multimedia in a computer-based learning system positively impacts the learning outcomes (Mayer, 2017). The multimedia choice as a gamification element such as photo, video, audio, text, and animation, etc. is discussed in detail in Chapter 3, Section 3.5. During the interviews, the researcher clarified the significance of this element in the research is to choose suitable multimedia that help to deliver the learning objectives of the game.

(Code 1) In the initial categorisation part of the interview, *four participants* identified the media choice *as a teacher-driven* task, and *one* regarded the task as *a shared task*, as illustrated in Table 5-3. Interestingly, there was an inconsistency between participants' categorisation and comments provided, by the same participants, through the discussion and utilisation later in the interview.

The contradiction appears in the (P1)'s chose the task as teacher-driven and stated: "It's my decision, what matters in media choices. However, a game developer might be consulted due to greater experience in game design". The comment suggests that the participant's categorisation is a shared task. Moreover, during the task, P1's utilisation highlights the need for guidance. This shows inconsistency between the decision and the actual application of the element.

(Code 2) During the task design, *all six participants chose the multimedia used in their design, with only half the participants demonstrate confident utilisation*. P2 was sure of her choices and matched the choices properties with the need for the game to fulfil the learning goal. P2 P3 and P6 choices were varied, e.g. pictures, video and audio all used to enrich the learning experience. Furthermore, P3 used media for the various aim of the game such as to explain, to encourage and to represent groups identity by profile pictures "using clapping sound for correct answers" and "adding a GIF of balloons and fireworks at the end of the exercise" (P3).

The remainder participants, P1, P4 and P5, utilisation reflects a need for guidance. P1 hesitated before stating her choices, and the researchers had to ask where the media would be placed on the screen to provide more information to sketch. *P4 only used pictures with no other media consideration* or utilisation for more screen elements. *P5 illustrated a basic utilisation of images to reflect the storyline* of the game. However, the media was not utilised further to reflect the learning activity or explain any learning objectives. Therefore, the participants' utilisation demonstrates a need for different multimedia suggestion, which should reflect vibrant options to be considered in a world of games. The multimedia included in computer-based learning system a are videos, animation, music and audio (Mayer, 2017).

Summary, the literature review clearly indicates the importance of multimedia in gamification design. *All participants utilised this element, which suggests a good level of understanding*. Nonetheless, there is a need to provide *a supporting list for multimedia*, which was evident in P1, P4 and P5's utilisation. The three participants' options were limited and did not reflect the nature of a game. The different multimedia options could include videos, animation, music and audio, which are all components of a computer-based learning system (Mayer, 2017).

Element 4. Timing

Timing as a gamification element is discussed in detail in Chapter 3, Section 3.5. It is significant to allocate each task duration as Kapp (2012) pointed out the importance of balancing task duration as a crucial learning session achievement indicator. While it is essential to have enough time to meet the learning goal in each screen, however, leaving the task without time constraints might lead to a low sense of achievement. Ašeriškis and Damaševičius (2014), which reviewed gamification design patterns in existing systems, found that time constraints are used to motivate players or system users. Therefore, learning game must provide a sense of antecedence for players.

(Code 1) In the initial categorisation part of the interview, *three (3) participants* identified timing as a *shared task*. On the other hand, *three (3) participants* initially perceived this element *as a teacher-driven task*, justifying that the teacher is more aware of *the individual differences amongst students*. As P1 commented, "*timing will be determined based on the game itself and student's abilities*". P5 stated "*Taking into account individual differences*". An interesting suggestion by one of those participants, who hesitated to classify this task, to provide the teacher with a timer function to provide flexibility in changing the duration of the learning task based on students' abilities. P3 stating "I *suggest leaving the timer setting for the learning tasks as something I could set myself depends on the student's level* to avoid depressing students". Therefore, the individuality of skills that each student has can be addressed by setting a function to allow teachers to set different timing for each group based on their abilities.

(Code 2) The task design emphasises that timing is a teacher-related task with *five (5) teachers confidently utilised timing* for the provided learning tasks. P1 initially identified timing as a shared task, and her utilisation illustrates a good understanding of timing changes in her comment "I will suggest a different time for tasks and increase duration when exercise expected to be more challenging for students" (P1). P1's provides certainty of what needs to be addressed by the game developer, which is the exact duration. The participant is aware of the timing increase according to difficulty. Thus, the information provided a baseline for the game developer to integrate timing element into game design. Although most of the participants demonstrated confidence in assigning durations for the learning tasks, the times given were fixed. The static nature of learning tasks duration goes against participants' early comments. The discussion with participants implied the need for recognising the individual players' differences. However, the fixed times assigned to the learning task shows no acknowledgement of individuality amongst students.

Summary, *both initial categorisation and task-design utilisation illustrated the importance of timing as a gamification element and their high correlation with teachers' pedagogical knowledge*. They also indicated a relationship between learning-task duration and students' individual abilities. This suggestion was identified at different stages of the process and was made by two participants, P3 and P1. P3's suggestion was to create a function to allow teachers to set different timing requirements for each group based on their abilities. During in-practice utilisation, P1 predicted that time spent accomplishing a task would increase according to difficulty. Based on the foregoing discussion, a flexible mechanism implementation is required to customise the task's duration according to different students' paces. Along similar lines, Faghihi *et al*. (2014) discussed individual players' learning speed differences and implemented the game in a way that specified the task's duration according to each individual's pace. *The sub-elements of timing were three task durations: below average, average and above average*.

Element 5. The social engagement plan

The social engagement plan covers a lot of interaction amongst players such as collaboration, mentorship, competition and conflict (Kapp, 2012; Chou, 2016; Özdener, 2017), which is discussed in detail in Chapter 3, Section 3.5. Kapp explained the interaction between players as 'behavioural rules' "Rules that govern the social contract between two or more players. These rules are game etiquette." (Kapp, 2012, 278). However, this research referred to the gamification element as social engagement plan to avoid concept confusion with Rules as an independent element.

(Code 1) In the initial categorisation part of the interview, *three (3) participants identified social engagement plan as a teacher-driven* task while the other *three (3)* perceived social plan as *a shared task.* Interestingly, no participant perceived the social plan as a game developer's task

(Code 2) During the task design, *four (4) participants utilised social element confidently, and one needed guidance.* Only one participant did not apply the social plan, as illustrated in Table 5-3. The need for guidance was reflected in P1's utilisation of the social plan. While P1 mentioned the benefits of cooperative learning among students, P1's utilisation needed guidance. Whereas, the game planned to students taking turns to play but no collaboration or competition involved with no task division for students.

Furthermore, P2 misinterpreted the element by applying a contact between teachers and students. P2 stated, "I prefer the interaction between teachers and students to be by email". However, when the researcher explained the social engagement in this research, the participant seemed to continue with her initial design plan with no further change. *The game P2 planned is an individual game*. The individual game design is missing in the literature as one of the options. This illustrates the need to signify an individual game as a social engagement plan option.

(Code 3) During the discussion, *four participants recognised cooperative play* as a suitable social plan for primary pupils age. P5 stated, "primary school age group are cooperation environment to learn". Interestingly, are the same participants who utilised the element confidently P3, P4, P5 and P6. *P4 planed a collaboration plan* for the class to participate in solving a puzzle that introduces the lesson. P4 "I preferred cooperation for young pupils while *a combination of competition and cooperation* is for older groups" in her utilisation the whole class supposed to participate in solving the puzzle. Similarly, P5 planned a collaboration, however, amongst a smaller number of students where each class has several teams. However, there was no competition planned among the teams. Another utilisation of both *cooperation and competition is planned by P3 and P6*. Also, both participants used the *groups' scores to reinforce the competition amongst teams* which reassemble the leaderboard concept. However, the leaderboard in this research is regarded as a reward mechanism and discussed independently. Furthermore, *P3 suggested that in a competition amongst teams removing the replay option to provide a fair chance*, the Replay option will be discussed independtly.

Summary, f*ive participants provided a social engagement plan, which illustrates a high relationship to pedagogy*. The teachers' discussions reflected a good level of interest in this element and related the social plan with team scores and the leader board. The discussion illustrated *a relationship with rewards*; the reward structure is discussed further in Element 7. Another suggested *relationship is with the replay option*; this detail is discussed further in Element 8. One participant's utilisation *illustrates the need to add the individual plan as a sub-factor of social engagement alongside cooperation, collaboration and competition, which is a valid design decision*.

Element 6. Number of players

The number of players is an essential requirement to build a game. Therefore, it was included in the framework. Although this element is analysed independently, the participants seemed to merge the element with the social engagement plan. The social engagement represents a broader perception that could accommodate the number of players.

(Code 1) In the initial categorisation part of the interview, *three (3) participants identified the number of players as a teacher-driven* task while the other *three (3)* perceived it as *a shared task.* Interestingly, the *categorisation is consistent with social engagement plan categorisation*. Furthermore, during the discussion (Code 3), *the comments provided by the participants are similar to their comments about social engagement plan, acknowledging the benefits of collaborative and cooperative learning*.

(Code 2) During the task design, *four participants utilised the element confidently*. P1, P5 and P6 specified the number of players in every team while P3 did not specify a number but assumed that based on a total number of students in a class, the group number would be assigned. P2 did not refer to the element specifically, though the game sketched seemed like an individual game.

Summary, *both Initial categorisation and task-design utilisation both illustrated the importance of number of players as a gamification element and the high relatedness with teachers' pedagogical knowledge*. Moreover, due to the similarity between the number of players and the social engagement plan described in the participants' discussion, *the number of players merged as a sub-factor of the social engagement plan*(Element 5).

Sub-theme 2: Less commonly used pedagogical elements of gamification

Element 7. Reward structure

The reward structure could be applied through different mechanisms such as points, badges and leaderboard which are all used to promote extrinsic motivation (Kapp, 2012) and (Chou, 2016), the difference between extrinsic and intrinsic motivation is provided in Chapter 2, Section 2.4.1. According to Sailer *et al*. (2017), badges and points, as a gamification element, fulfil the players' sense of competency by providing feedback, which advances the task significance for players. The leaderboard has been interchangeably regarded as a rewards mechanism or social engagement. In this research context, the leaderboard is a reward mechanism used as extrinsic motivation. A discussion of reward mechanisms and its benefits and disadvantages is provided in Chapter 3, Section 3.5.

(Code 1) In the initial categorisation part of the interview, *five out of six participants* identified rewards *as a teacher-driven task*. Only P2 perceived the task as a game developer's task. P2 stated, "It must exist, but I will leave the presentation of rewards or points to the game developer". P2's

statement reflects a shared task with game developers and implies *that the reward structure decision has already been made by the teacher, and the game developer is suggesting visual representation options*.

(Code 2) However, during the task design, *four participants*, P1, P2, P4 and P5*, did not apply rewards* as illustrated in Table 5-3. P4 stated, "*the reward would be a chocolate bar or points added to course grades*" P4 *misapplied the concept by using a non-electronic form*, i.e., treat from the box type which does not bring the element to the electronic form that was the aim of the task. On the other hand, the *two remaining participants, P3 and P6 utilised rewards confidently*. Both participants defined a rewarding mechanism that includes collecting points and adding points to the teams' score, which is also demonstrated in Tenório *et al*. (2016) and Pineda-Corcho and Moreno-Cadavid (2017). *Associating rewards, which is the teams' score, with social engagement*. However, only P3 and P6 relate the rewards to promote competition. *P6 connected the scoring mechanism to the number of attempts.* The first attempt will have two points, one added to the team and the other to individual player score, whereas the second attempt will add a point to the individual player score and not the team. Otherwise, more attempts will add no points to either. Furthermore, the final system scores will be traded for gifts from the school shop as canteen vouchers. Similarly, *P3 explained that every correct answer would add a point to the score. However, the incorrect answer will move the student to the next exercise with no points added*. The difference lies in the ability to replay the incorrect task. P3's design will not allow a replay whereas *P6 provides the replay option without points added to the team's score*.

(Code 3) During the discussion, four participants, P1, P2, P3 and P4, emphasised the importance of rewards from a pedagogical perspective. P3 and P4 agreed that rewards must always be presented on the screen to motivate players. *P3 stated, "I encourage rewards existence in all circumstances*". Also, *P4 stated, "Always show the score to motivate the student and add enthusiasm to the game*". The participants' opinion is in line with Chou (2016) that acknowledges stating the player's points would motivate players. Another interesting comment made by P1 stated, "*Offer it as an individual encouragement to students not to the group*". When the researcher asked for clarification, P1 explained the positive impact on the individual, but the other students who are achieving less might be discouraged. P1's concern regarding the player's discouragement is in line with Chou (2016) view.

Summary, *regardless of the high pedagogical relatedness of rewards, which was suggested in -theory (Code 1), only two participants utilised it*. Both P3 and P6 *relates the successful completion with points, which limits the reward other options*. One participant misapplied the rewards concepts using some type of rewards in class, i.e. sweets from the jar and achievement certificates. Applying a non-electronic form does not transform the reward concept to the computer-game experience. Therefore, *the reward in an electronic form needs to be reinforced by providing examples of*

electronic forms such as points, badges. There is a need to ensure that *other students' points will not be visible to avoid demotivating to individuals as advised by P1*.

The utilisation of P3 and P6 *emphasised a relationship between Rewards and Social engagement.* Another suggested relationship amongst *the gamification elements is between Rewards and the Added excitement curve (i.e. bonus points)*; added excitement is discussed further in Element 11

Element 8. 8. Replay option

The replay option referred to as 'freedom to fail' by Botha and Herselman (2015) and Goshevski *et al.* (2017). Chou (2016) discussed 'loss and avoidance' as an element to evade in gamification design, i.e., avoiding the player's feeling they are losing their achievement in a game. Summary, references agreed on the benefit that providing a replay option will prevent negative emotions, and allow multiple trials to achieve a particular goal (Kapp, 2012).

(Code 1) In the initial categorisation part of the interviews, *four (4) participants categorised the replay option as a teacher-driven, and two (2) identified it as a shared task*, as illustrated in Table 5-3.

(Code 2) During the task design, *three (3) participants did not refer to the replay functionality in their designs, while one participant needed guidance. On the other hand, two (2) participants utilised the element confidently*. The lack of utilisation contrasts the participants' initial decision of in-theory categorisation as a teacher-driven task. *P2 utilisation needed guidance as the participant mentioned the replay option would be provided to students with no details on when the option will become available*. For example, will this button be initially on every screen? or rather appears in cases of incorrect attempts. A confident utilisation elaborating with details was demonstrated in both P4's and P3's designs. P4 stated, "My game is simply an introduction; the screen will provide two options. *Undo the last move and the option of resetting the puzzle*". Even though in her discussion, she was concerned with the fact that *the replay option might lead to boredom*. The other confident utilisation by P3, which relates the availability of the replay option to the social engagement plan. P3 stated "the replay option is related to the type of the game. In this game, *there is competition amongst the students' teams. I think providing a replay option would make the competition loses value.* But, they will be moved to the next exercise with *no points added*". Even though, during the discussion, the participant was certain that this option should always be available in a learning game yet decided against applying the element.

(Code 3) During the discussion, *all participants agreed that replaying from the last successful point is essential to reinforce the learning objectives*.

Summary, *The Replay option in-theory categorisation varied between teacher-driven and shared tasks*. Nonetheless, *all participants agreed that, from a pedagogical perspective, the game should*

always keep the replay option feasible. However, *this was less strongly emulated in the task design, as three out of six teachers did not utilise the replay element*. Moreover, the participants agreed that, at the very least, *students should not restart the game from the beginning, but should complete it from the last successful stage. This was in line with P4's concern of leading to boredom, which suggests that only a limited number of attempts should be offered before moving to the next part of the game*. The evolved decision by P3 illustrates that the task design sketch provided an in-depth context for the element's applicability; therefore, it informs teachers' context and choices. P3's utilisation *suggested a relationship between the Replay option and Social engagement, where the competition dictates no replay option*. Another suggested connection, offered by the same participants, was *between the Replay option and Rewards (i.e. when a replay occurs, no points will be added).*

Element 9. Controls

Controls are the input mechanism used to communicate the interaction between the player and the game, such as keyboard mouse, touch screen and voice command or output feedback, as discussed in Chapter 3, Section 3.5.

(Code 1) In the initial categorisation part of the interview, *three (3) participants identified the choice of the controls as a teacher-driven task, and two participants referred to the controls as a shared task*. Only one perceived the task as a game developer's.

(Code 2) During the task design, *only one participant*, P4, *utilised the element confidently*, as illustrated in Table 5-3. The remaining *five (5) participants' utilisation showed a need for guidance.* P4 confidently chose the controls confidently for a puzzle that introduces the lesson that does not imply a variety of input mechanism and the participant was able to make a decision and provide an alternative as well. The participant stated, "If I had a smartboard will use a pen or simply the mouse if using a projector" (P4). The ease of utilising the element might be due to the game type, which is a puzzle, which dictates simplicity. One participant, *P6, mentioned a broad command by saying 'choosing, clicking' without specification of how the choice would be communicated through the game*. P6 utilisation showed generalisation by stating "by clicking" multiple times which suggests different controls such as touch screen, smartboard or a mouse. Interestingly, P6 perceived the controls as a shared task in the initial in-theory categorisation. The vagueness might be due to the expected addition form the game developer. Another participant, P2, addressed the need for the game developer's expertise stating "*I will explain the goal of exercise or screen to the game developer and discuss my options to determine which input method more suitable for my learning objective*" (P2). P2's comment contrasts her initial in-theory categorisation, where the participant perceived controls as a teacher-driven task. Another guidance was needed by both *P1 and P5, asking the researcher to provide examples later, the participants chose the suitable controls*. *In contradiction of P1's initial in-theory categorisation that controls decision is a game developer's*

task, the participant asked for more details and utilised the element. *All three participants*, P1, P2 and P5, *needed a list of options*.

Summary, *all participants chose controls despite the initial variation categorisation given, which illustrated high pedagogical relatedness*. Nonetheless, five participants' utilisation showed a need for guidance. Specifically, it is necessary to provide *a supporting list for controls*, which was evident in the utilisations of P1, P2 and P5.

Sub-theme 3: Non-pedagogical elements of gamification

Element 10. Storyline

The game idea and storyline as a gamification element is discussed in detail in Chapter 3, Section 3.5. This is significant as it provides a narrative and a theme to connect all tasks. Villagrasa and Duran (2013) point out the benefits of a storyline to provide a context. Similarly, Chou (2016) refers to the narrative as a meaningful addition to the game. Along similar lines, Kapp (2012) suggests having a storyline to add depth to the game experience and makes the instructional material more engaging nonetheless, to provide an indicator of the game's expected directions or actions.

(Code 1) In the initial categorisation part of the interviews, *all participants agreed that having a storyline will improve students' engagement.* Four participants chose the storyline task to be teacher-driven. The remaining two identified the storyline as a shared task, as illustrated in Table 5-3.

(Code 2) During the task design, *three (3) participants did not apply storyline. Only one participant utilised confidently while two needed guidance*. Only one participant, P3, was able to connect the game through a comprehensive storyline. As part of the gamified learning experience, P3 planned a theme for the teams and used the storyline to build a quiz. Interestingly, she initially identified inventing a storyline as a shared task with the developer. However, her utilisation does not support the prior premise, i.e. the role of the developer was not recognised. Yet, demonstrated a good grasp of the concept applicability such as using characters, visual presentation, plots in the storyline (Kapp, 2012). Another utilisation illustrates a *facile use of storyline* element presented *by two of the participants* P1 & P5. *They started the design with a storyline for the first screen. Nevertheless, the element was not utilised further to connect other tasks of the game*. This suggests the need for guidance to direct the sustainability/attainability of a storyline along with all possible tasks in the game. Another participant reflects more stabilised perception both in-theory categorisation and in-practise utilisation. *P2* perceived the storyline as a shared task moreover, during task design, preserved her choice by *referring to the developer expertise* in this element. Despite P2's reference of characters as the storyline, which is discussed previously, *no suggestion was made to create any visual themes*. This reflects the poor alignment of the storyline as a gamification element. Lastly, *two of the participants P4& P5 perceived the game storyline as a teacher-driven task in- theory,*

however, during the task design, both participants did not refer to any storyline aspects and presented the games as independent tasks and questions on a screen. Interestingly, one of the two participants (P4) during the discussion commented: "I would love to check that the story is suitable with learning objectives". The provided comment *implies that someone else made the storyline,* and the teacher's role is mainly supervisory.

(Code 3) However, in the discussions, one participant *P1 suggested the need for a storyline to be associated with the time allocated for the game out of the full lesson duration*. In P1's view, *some game types would not require a cohesive storyline to guide a limited number of simple tasks*. This is in line with Kapp's (2012) concept, which acknowledges the existence of games that have stories and others that have not. According to Kapp (2012), games have existed over the years simply without a need for a storyline, e.g. Tic-Tac-Toe. In addition, Kapp suggests the existence of games with a storyline and characters to devise the game flow and rules, e.g. Chess, which has characters and ranks that build a context and a plan of the player's possible routes. P1's hypothesis seems to present a significant point for consideration when building a storyline for a game. In this regard, it is logical to consider the duration of the game as a parameter that impacts upon the necessity of creating a storyline.

The simplicity of utilisation is an additional notion of the storyline postulated by another participant. *P2 suggests having a storyline such as a familiar cartoon character on the screen as the simple and yet useful visual presentation to start an acquaintance with students*. This utilisation is in line with Botha and Herselman's (2015) work that represents the storyline as an interactive image illustrating the learning goals from the start to the end (Botha & Herselman, 2015). As Kapp (2012) states, aspects of a game storyline include character, plot, tension and resolution. Therefore, a character represents an aspect of a storyline as a gamification element alongside others. *P2's perception illustrates* a limited understanding of the storyline element components and *suggests a facile storyline*.

Summary, the he participants' utilisation of a storyline as a gamification element identified different levels of applicability. *Three participants applied a storyline. Only one participant utilised it confidently, while two needed guidance.* The storyline has two sub-factors to improve teachers' utilisation and provide guidance: *game span and expected game duration*. Firstly, *game span illustrates the number of session(s) of a certain game*. For example, is it a one-time in-class practise or a series of exercises to be played throughout a semester? Secondly, *the expected game duration* is the time spent on the game, which represents the relationship between Storyline and Timing as two gamification elements. For example, does the game involve a few simple tasks that take less than 10 minutes, does it take longer? Knowing this can help the game developer to think of the time needed to narrate a storyline or the tools that can be used to build a context. Both sub-factors'

significance is to guide teachers to the *relevant storyline standard, which was concluded from the foregoing discussion:*

- *A comprehensive storyline* for a game that is expected to last longer and be used by students on a regular basis was applied by P3. Such a game used in a course throughout a semester could have a cohesive story with a character. To follow the storyline, aspects suggested by Kapp (2012) include characters, plot, tension and resolution.
- *A facile storyline* that builds some interest and engages students, such as the representation of a familiar character for simple tasks, was applied by P1 and P5. For example, a game used for a lesson review may not need a full story.
- *No storyline* was applied to individual tasks by P2, P4 and P6.

Element 11. Add excitement in certain points

Adding excitement at different points of the game, e.g. adding a timing rule or bonus temporary levels is one of the gamification elements. The significance of this element is to maintain players' enthusiasm during the game to increase motivation and engagement. The literature conferred this element under different terms, such as 'challenge' by Sweetser and Wyeth (2005) and as 'curve of excitement' by Kapp (2012), Chou (2016) refers to the element as 'unpredictability and curiosity' and 'bonus scores' by Nunes *et al*. (2016), as discussed in detail in Chapter 3, Section 3.5. Nonetheless, references concordance to maintain different levels of excitement, which accordingly, will keep players engaged throughout the game.

(Code 1) In the initial categorisation part of the interviews, three (3) participants chose the curve of excitement to be a teacher-driven task, and one participant identified it as a shared task. Whereas, *two identified the curve of excitement as a game developers' task*, as illustrated in Table 5-3.

(Code 2) During the task design, *five out of six (5/6) participants did not apply any excitement or unexpected event in the sketch nor mentioned the need for it*. On the other hand, one participant, P3, utilised the element confidently by adding a pop quiz at the end of the game to allow teams to collect extra points.

(Code 3) During the discussion, the participants' general understanding relates the excitement to rewards. P6 associates the added excitement with class credits, stating "This could be applied by associating the student's course credit to the game score". The other participant's view relates the curve of excitement to simple virtual rewards. P2 explains "having a reward at the end of a lesson is one of the essential principles for me as a teacher. This could be something like a gift picture at the end of the game". P2 delegated this task to game developers, stating: "*I will leave* the progress presentation and the opportunity *to provoke excitement to the game developer*" (P2). The foregoing discussion illustrates a *limited grasp of the concept* to add excitement through rewards.

On the other hand, two participants identified this task as game developers. P4 Acknowledged the game developer expertise saying: "*the game developer should be familiar with this task,* as he/she has been designing for a while *and his/her experience exceeds mine*". Another in-theory categorisation credits to the game developers' experience. P1 referred to this task as a teacher-driven then changed the categorisation into a shared task. The researcher asked for a justification for the alternation and P1 replied: "*while I think the game developer will have a variety of options more than myself*, I need to choose the suitable ones to my students". *Both P4 and P1 comments demonstrate the teacher's awareness of the critical technicality of this task and readiness to value and accept the game developers' input*.

Summary, the Added excitement in an educational game is a critical requirement to engage students. *Discussion with some participants about the added excitement showed an appreciation of the game developers' experience*, which is in line with *Kapp (2012) who referred to the curve of excitement as a game-designer's task*, as discussed in Chapter 3, Section 3.5. Furthermore, participants demonstrated a self-conscious attitude towards their skills' limit. *This element was used by only one teacher, which emphasises the non-pedagogical nature of the element*. *Therefore, the added excitement as a gamification element should be moved with the HCI elements to the category of game developers' tasks*. The limited grasp of the element suggests a need for a *supporting list of excitement mechanisms* as a sub-factor alongside *the suggested time* to provoke these mechanisms.

Element 12. Rules

Setting rules as a gamification element has a limited discussion in the literature review, as outlined in Chapter 3, Section 3.5. This research adopts Kapp's operational rule concept, which clarifies how the game is played , i.e. the events, actions and the expected results (Kapp, 2012). The perception of rules was explained to the participants using examples to avoid confusion. The rules are significant to build the game structure and direct the players.

(Code 1) In the initial categorisation part of the interview, two (2) participants perceive rules as a teacher-driven task, and only one participant chose to keep the element as a shared task. The remaining *three (3) participants assign the task to game developers*, as illustrated in Table 5-3.

(Code 2) During the task design, *defining rules as an element was not applied in-practice by three participants P1, P2 and P5. Only P4 utilised confidently while P3 and P6 needed guidance*. P4 in designing a puzzle proposed simple rules. Whereas, *two participants, P3 & P6, provided rules that misapplied the concept*. One participant utilised the *rule as a navigation mechanism, i.e., the correct answer will move the player to the next screen. The participant's suggestion could cause frustration for students*. Yet, there was *no action in the design that reflects a game-nature*. Another participant *misapplied the concept of rule and utilised it as in-class disciplinary. For example, using the games*

as a reward when students are behaving well. However, both participants' utilisation of the element does not convey the concept of game rules that engage the students and illustrate the game flow and actions.

(Code 3) During the discussion, one participant, *P3, perceived rules as a teacher-driven task, stated conversely, "rules need to be compatible with my learning objectives*" (P3). The provided comment implies that the teacher's role is supervisory. *P4 justified identifying rules as a game developer's stating, "this element covers technical details*" (P4). P4's comment indicates the teachers' raised appreciation of game developer's role.

Summary, the *participants demonstrated an appreciation of the game developer's expertise in devising rules* more than any other elements in this research. *Three (3) participants assign the task to game developers. This was clear in the categorisation as three participants designated the element for a game developer. Moreover, half the participants did not utilise the rules in-practice. Furthermore, there is no suggested relation between Rules and any other gamification elements. Therefore, the Rules as gamification elements should be moved with HCI elements as game developers' task*.

Element 13. Learning progression presentation

The Learning progression presentation as a gamification element is referred to as feedback; further discussion is provided in Chapter 3, Section 3.5. Presenting the player's performance is a useful strategy to motivate players (Chou, 2016 ; Steinberger et al., 2017). The presentation could be a progress bar, as mentioned in (Lameras & Moumoutzis, 2015 ; Chou, 2016). Another presentation of progress is an interactive image illustrating the learning goals on a pathway from the start to the final goal, and every achievement is reflected in the image as a highlighted badge (Botha & Herselman, 2015). Published work by (Markopoulos et al., 2016) suggested that leaderboard is a type of feedback which includes other players' progress. However, in this research, the element is addressing individual reference for personal achievement, which is in line with Toda *et al*. (2015) perception.

(Code 1) In the initial categorisation part of the interview, three participants identified the element as a teacher-driven task. On the other hand, *two participants referred to the element as a game developer's task*. P6 is the only participant who perceived the task as shared.

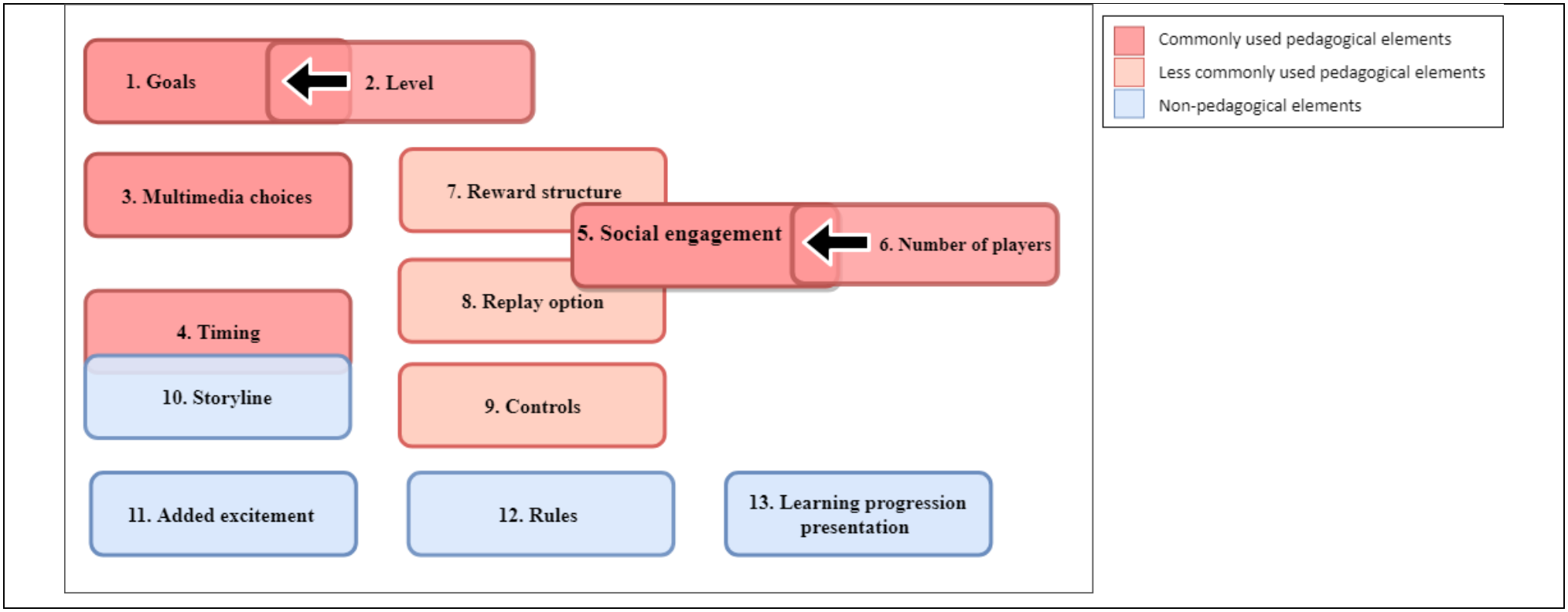
(Code 2) *During the task design, no participants utilised the element in the sketch*. However, *one participant referred to the importance of the element without any suggestion of application*. *P2* said, "*I will leave the progress presentation* and the opportunity to provoke excitement *to the game developer".* The participant statement reflects her initial categorisation of the element to be a shared task. Apparently, the participants are expecting a discussion with the game developer, which she stated "*I want to hear what options are available to display the student progress through the*

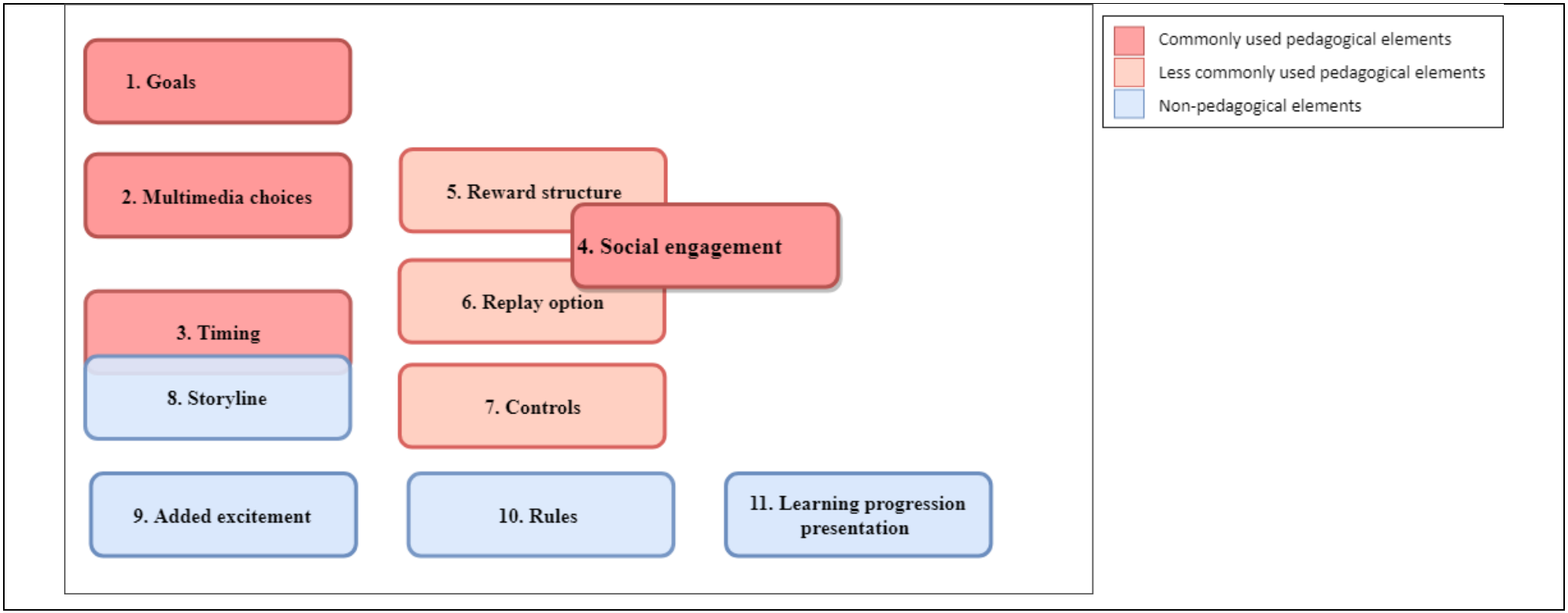
game and decide which one suits my student considering their age. However, I will leave the place of the representation on the screen for the game developer" (P2). The participant's comment suggests a need for options to provide ideas for teachers.

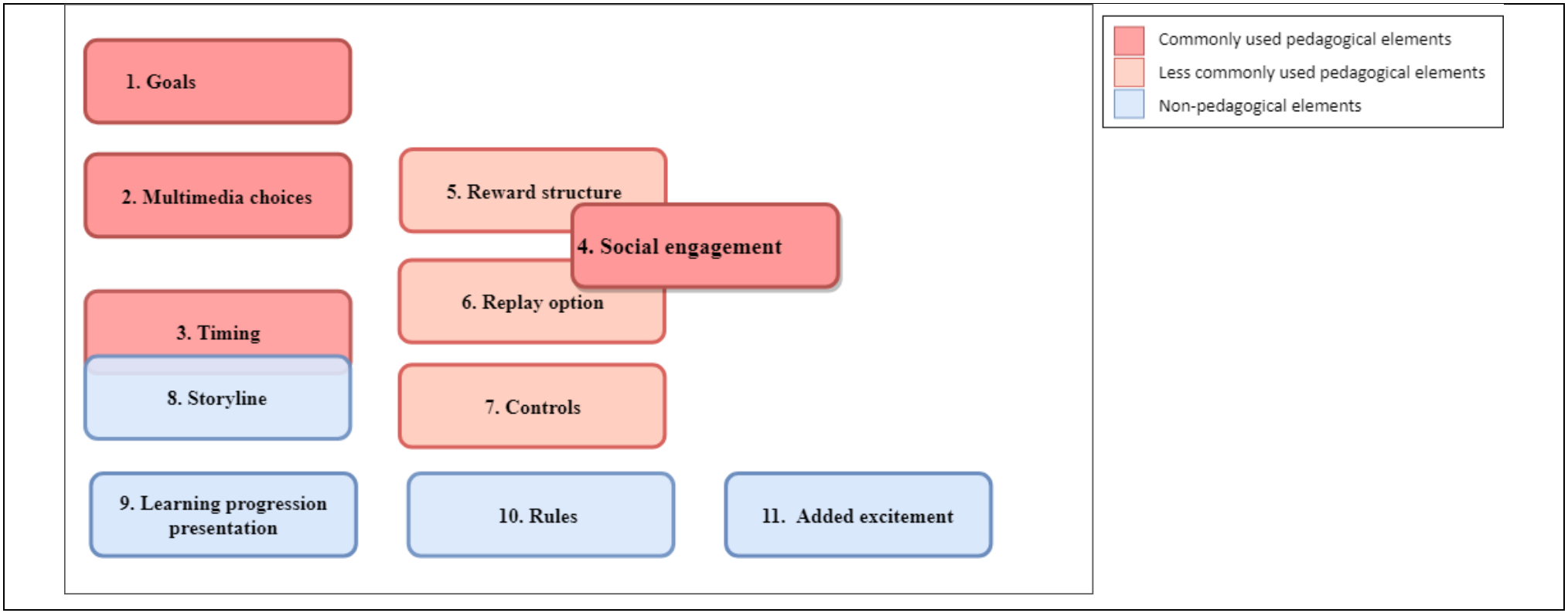
(Code 3) P1 identified the learning progression presentation as a teacher-driven, whereas P4 as a game developer's task. However, both agreed upon the importance of individual reassurance provided by this element. For example, P4 stated, "It is important to include the element for every student, but, *I would leave the decision for the game developer*". Whereas, P1 "It is crucial to encourage students, so I am the person in charge of this task". A misapplication of the element was clear in P3's discussion. P3 said, "I prefer to keep it seen to be a motivation for the player and everyone else". A follow-up explanation by the researcher that group progression presentation is out of this element's scope. The focus of this element is the individual learning progress presentation.

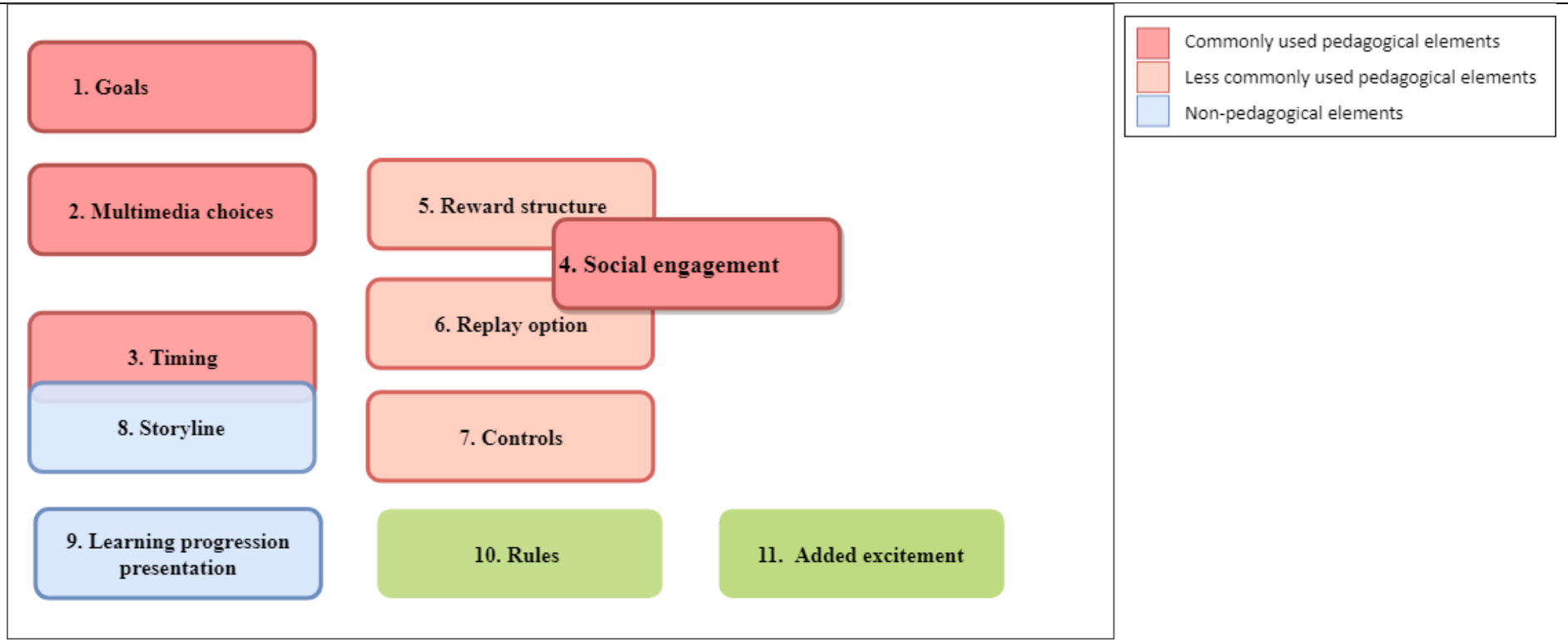
Summary, discussion with the participants illustrated that providing performance feedback is crucial and could motivate players. Through initial categorisation, it was anticipated that this element is a key focus for teachers, which is in line with (Naik & Kamat, 2015; Chou, 2016; Steinberger et al., 2017). However, this was not supported by the task design practice. *Lack of utilisation in practice did not reflect the level of importance.* This might be due to participants' fatigue during the interview, as this element was discussed at the end of the provided gamification elements list. The framework should include *a supporting list of presentation examples*, as P2 suggested.

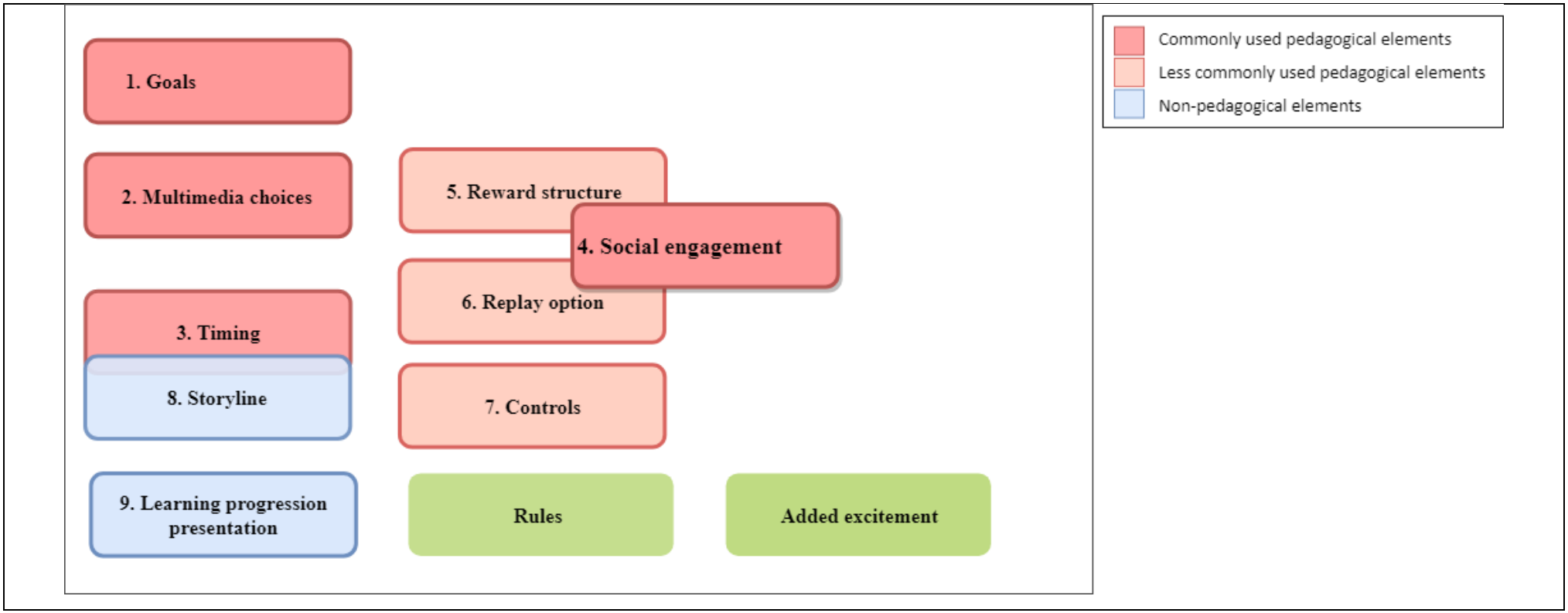
Appendix E.5. The Update on the Gamification Elements According to the Theme-1 Findings



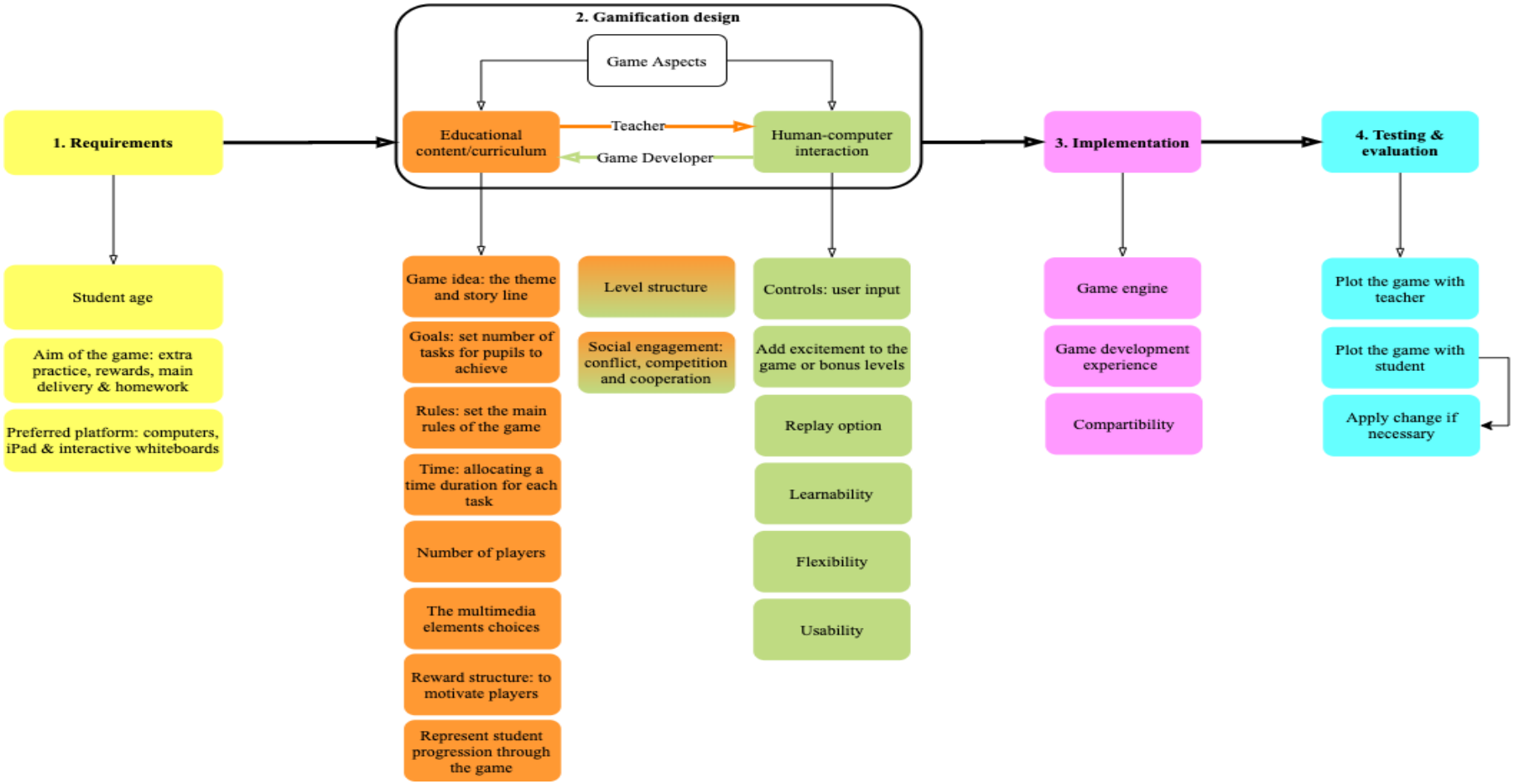

1. Goals
2. Multimedia choices
5. Reward structure
4. Social engagement
6. Replay option
3. Timing
8. Storyline
7. Controls
9. Added excitement
10. Rules
11. Learning progression presentation
Commonly used pedagogical elements
Less commonly used pedagogical elements
Non-pedagogical elements

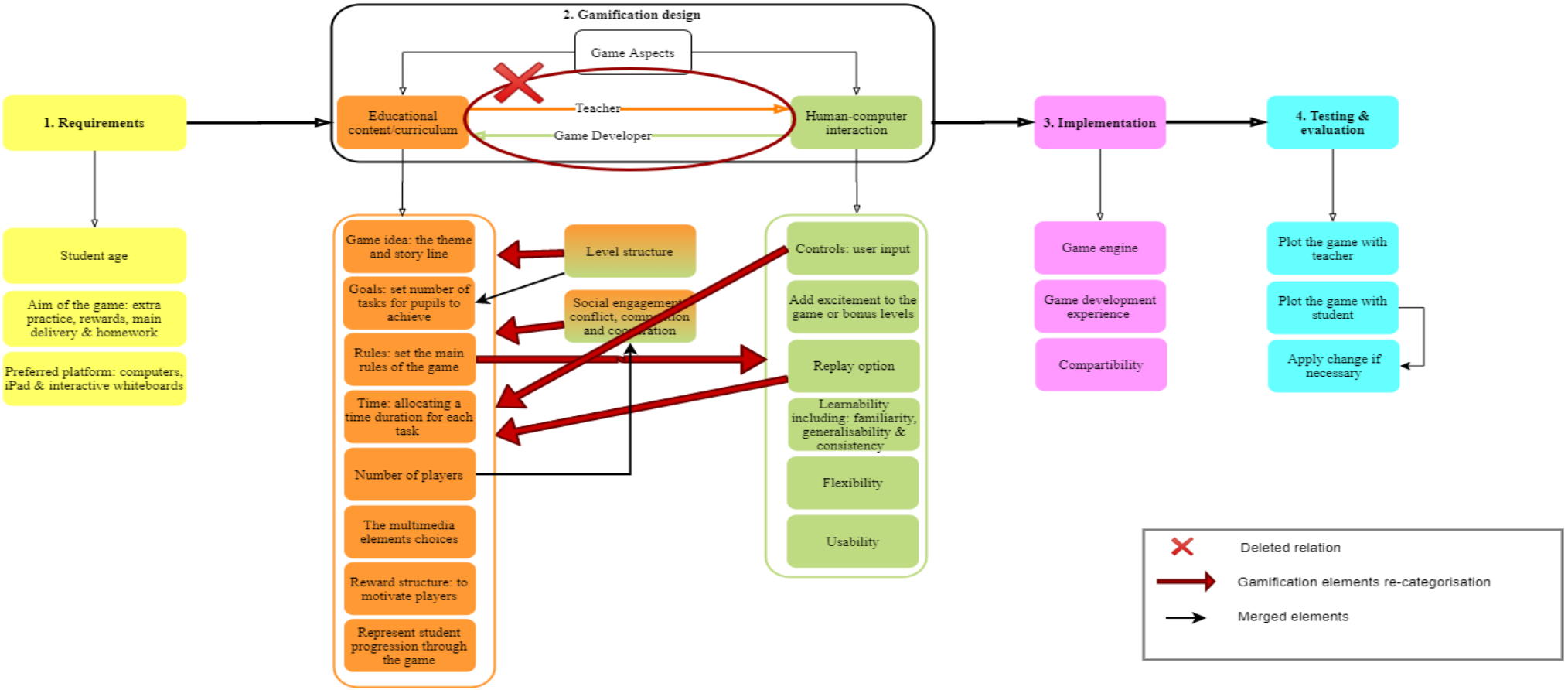

1. Goals
2. Multimedia choices
5. Reward structure
4. Social engagement
6. Replay option
3. Timing
8. Storyline
7. Controls
9. Learning progression presentation
10. Rules
11. Added excitement
Commonly used pedagogical elements
Less commonly used pedagogical elements
Non-pedagogical elements

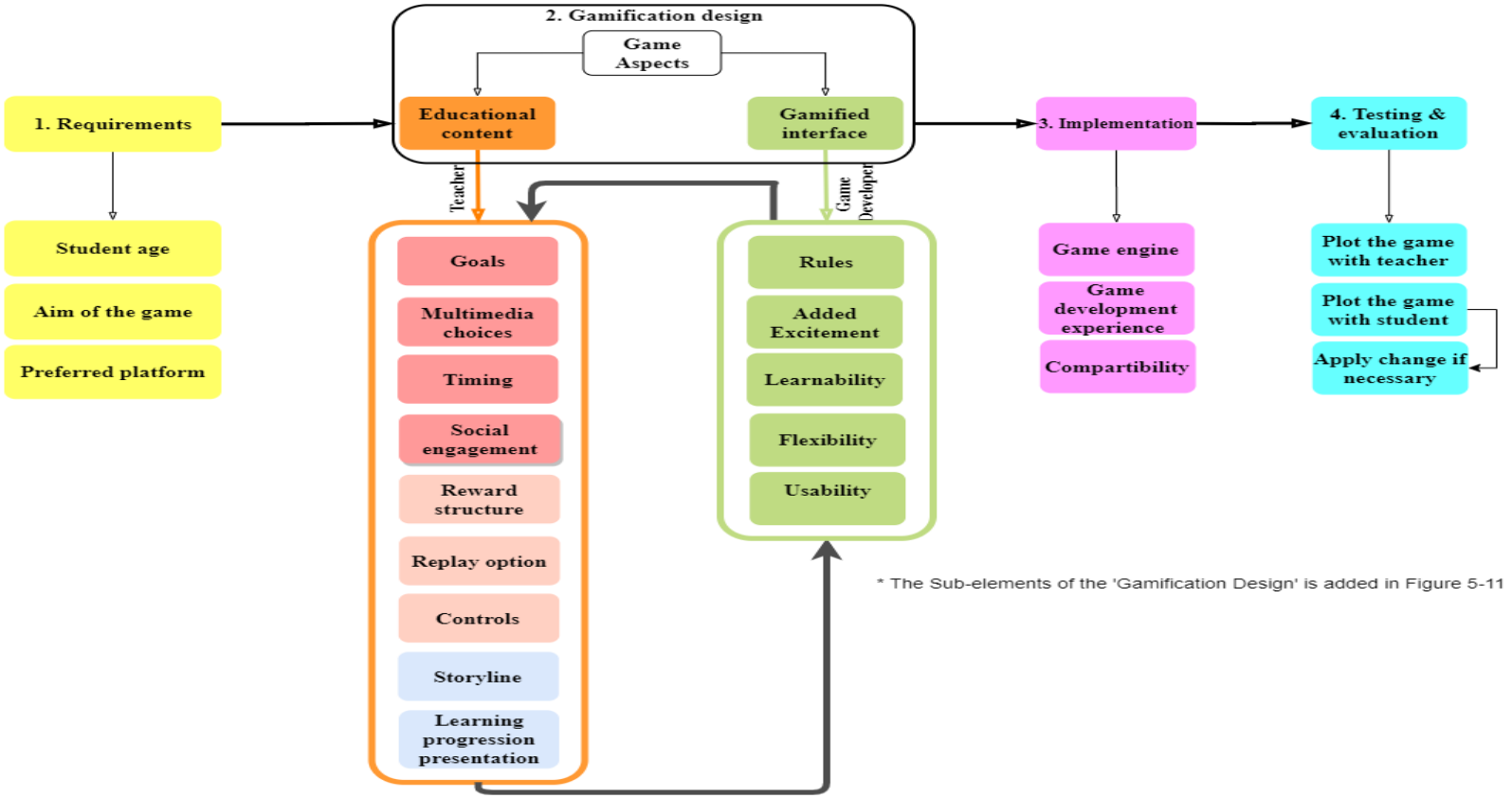

1. Goals
2. Multimedia choices
5. Reward structure
4. Social engagement
6. Replay option
3. Timing
8. Storyline
7. Controls
9. Learning progression presentation
10. Rules
11. Added excitement
Commonly used pedagogical elements
Less commonly used pedagogical elements
Non-pedagogical elements


1. Goals
2. Multimedia choices
5. Reward structure
4. Social engagement
6. Replay option
3. Timing
8. Storyline
7. Controls
9. Learning progression presentation
Rules
Added excitement
Commonly used pedagogical elements
Less commonly used pedagogical elements
Non-pedagogical elements

Appendix E.6. The Process of Changes from Version 2 to Version 3 of the AH-GPD Framework




1. Requirements
Student age
Aim of the game: extra practice, rewards, main delivery & homework
Preferred platform: computers, iPad & interactive whiteboards
2. Gamification design
Game Aspects
Educational content/curriculum
Teacher
Game Developer
Human-computer interaction
Game idea: the theme and story line
Goals: set number of tasks for pupils to achieve
Rules: set the main rules of the game
Time: allocating a time duration for each task
Number of players
The multimedia elements choices
Reward structure: to motivate players
Represent student progression through the game
Level structure
Social engagement
Controls: user input
Add excitement to the game or bonus levels
Replay option
Learnability including: familiarity, generalisability & consistency
Flexibility
Usability
3. Implementation
Game engine
Game development experience
Compartibility
4. Testing & evaluation
Plot the game with teacher
Plot the game with student
Apply change if necessary
Deleted relation
Gamification elements re-categorisation
Merged elements


1. Requirements
Student age
Aim of the game
Preferred platform
2. Gamification design
Game Aspects
Educational content
Gamified interface
Teacher
Game Developer
Goals
Multimedia choices
Timing
Social engagement
Reward structure
Replay option
Controls
Storyline
Learning progression presentation
Rules
Added Excitement
Learnability
Flexibility
Usability
3. Implementation
Game engine
Game development experience
Compartibility
4. Testing & evaluation
Plot the game with teacher
Plot the game with student
Apply change if necessary
* The Sub-elements of the 'Gamification Design' is added in Figure 5-11

Appendix F. The Game Developers Interview Questions

Start of Block: Consent Form

Please read the experiment process carefully:

1. An information sheet is provided so you understand the intention and purpose of the research project that will be conducted.

2. Your participation in the project is voluntary and you will have the right to withdraw from the project at any time.

3. Any data collected will be treated confidentially and made immediately anonymous.

4. You may contact the student's supervisor if you require further information about the research project.

5. You may contact the Chair of the Faculty Ethics Committee at Staffordshire University, if you wish to make a complaint relating to involvement in the research.

○ I agree to take part and confirm the project mentioned above has been explained to me.

End of Block: Consent Form

Start of Block: Experience and Background

1. Please can you describe your experience in games development?

○ Teaching game design

○ Industry experience

○ Gamers

○ Others

Display This Question:

If Please can you describe your experience in games development? = Others

1.1. If others, please specify

_____

2. How many years of games development experience do you have?

	0 2 4 6 8 10 12 14 16 18 20
Years	
Months	

3. Have you developed/co- developed an educational game?

- Yes
- No

4. In your opinion, do you think there is a difference between an educational game design and any other type of game?

- ○ Yes
- ○ No

Display This Question:

If In your opinion, do you think there is a difference between an educational game design and any ot... = Yes

4.1. If yes, what is the difference(s)?

_____

_____

_____

_____

_____

5. What type of game requirements format have you used?

- ○ Game Design Document (GDD)
- ○ Documentation template
- ○ Web pages
- ○ Others

Display This Question:

If What type of game requirements format have you used? = Others

5.1. If you are using other types, what are they?

_____

_____

_____

_____

_____

End of Block: Experience and Background

Start of Block: Gamified Interface Elements

6. Referring to the three Versions of the framework to illustrate the progress of game developers' role. The green boxes represent the game developer's task in the design process. (Using the presentation)

7. The element Rules has no sub-elements, from your experience could you suggest any?

_____

_____

_____

_____

_____

8. The remainder 4 elements which have defined sub-elements are Added excitement, Learnability, Flexibility and Usability. Based on your experience use the scale to define the applicability of the sub-element in relation to gamified learning design

9 Added excitement

	Applicable	Not Applicable
Supporting list of mechanism	○	○
Suggested time to provoke the mechanism	○	○

9.1. If there are other sub-elements, suggest them, please.

_____

_____

_____

_____

_____

9.2. Do you have any modification to the sub-elements wordings? If yes, explain.

_____

_____

_____

_____

_____

10. Learnability

	Applicable	Not Applicable
Predictability	○	○
Familiarity	○	○
Consistency	○	○

10.1. If there are other sub-elements, suggest them, please.

_____

_____

_____

_____

_____

10.2. Do you have any modification to the sub-elements wordings? If yes, explain.

_____

_____

_____

_____

_____

11. Flexibility

	Applicable	Not Applicable
Dialog initiative	○	○
Multi-threading	○	○
Task migratability	○	○
Substitutivity	○	○
Customisability	○	○

11.1. If there are other sub-elements, suggest them, please.

_____

_____

_____

_____

_____

11.2. Do you have any modification to the sub-elements wordings? If yes, explain.

_____

_____

_____

_____

_____

12. Usability

	Applicable	Not Applicable
Simple and natural dialogue	○	○
Speak the users' language	○	○
Minimize user memory load	○	○
Offer informative feedback	○	○
Clearly marked exits	○	○
Shortcuts	○	○
Good error messages	○	○
Prevent errors	○	○
Permit easy reversal of actions	○	○
Support internal locus of control	○	○
Help and documentation	○	○

12.1. If there are other sub-elements, suggest them, please.

_____

_____

_____

_____

_____

12.2. Do you have any modification to the sub-elements wordings? If yes, explain.

_____

_____

_____

_____

_____

End of Block: Gamified Interface Elements

Start of Block: Gamification Design Process Overall Review

13. Looking at the current version of the framework, in an educational game design context, is there any relevant element to be added?

○ Yes

○ No

13.1. If yes, what are they?

_____

_____

_____

_____

_____

31.2. Do you have any suggestion on the framework? If yes, explain.

_____

_____

_____

_____

_____

Appendix G.

Appendix G.1. The Evaluation Interview Questions

Participant ID.

How would you describe your experience in games development?

You may use the following aspects; teaching game design, industry experience, gamer, or others

	1	2	3	4	5	
Easy to learn	Not at all easy to learn	Not easy to use but could be with an explanation	Easy to learn but required explanation	Easy to learn with little explanation	Very easy to learn	
Easy to use	Not at all easy to use	Not easy to use but could be used with an explanation	Easy to use but required explanation	Easy to use with little explanation	Very easy to use	
Usefulness	Not at all useful	Not useful but could be considered to use	Useful, but would require some modification	Useful	Very useful	
Comprehensive	Not at all comprehensive	Not sufficiently comprehensive	Fairly comprehensive	Comprehensive	Very comprehensive	
Adaptability to various levels of computer literacy	Very advanced level	Not simple	Fairly simple	Simple	Very simple	
Intention to use	Not at all likely	Not likely, there were major modifications needed	Quite likely, but would require modification	Likely	Very likely	

Do you have any comment or suggestion on the template?

رقم المشارك	
هل هي مدرسة حكومية أم خاصة ؟	
ماهي المرحلة التي تُدرسها حالياً؟	
ماهي المواد التي تُدرسـ ها/يتها؟	
كم عدد سنوات الخبرة في التدريس؟	
هل سبق أن استخدمت الألعاب الالكترونية بالفصل ؟	
منذ متى و انت تستخدم الألعاب الالكترونية في التدريس ؟	
هل سبق أن صممت لعبة بنفسك ؟	

عناصر التقييم	١	٢	٣	٤	٥،	
سهولة التعلم (تلقائية)	صعب جداً	صعب	سهل، مع الحاجة لكثير من التوضيح	سهل مع الحاجة للقليل من التوضيح	سهل جداً	
سهولة الاستخدام	صعب جداً	صعب	سهل، مع الحاجة لكثير من التوضيح	سهل مع الحاجة للقليل من التوضيح	سهل جداً	
فائدة النموذج	غير مفيد على الإطلاق	محدود الفائدة، لكن يمكن استخدامه	مفيد، و لكن يحتاج الى تعديلات	مفيد	مفيد جداً	
شمولية العناصر	غير شامل على الإطلاق	غير شامل بدرجة كبيرة	شامل إلى حد ما	شامل	شامل جداً	
بساطة المستوى التقني	صعب جداً	صعب	متوسط	بسيط	بسيط جداً	
قابلية الاستخدام في المستقبل	لا، على الإطلاق	لا، لوجود الكثير من التعديلات على النموذج	من الممكن استخدامه، مع الحاجه لبعض التعديلات	من المحتمل	نعم، على الأغلب	

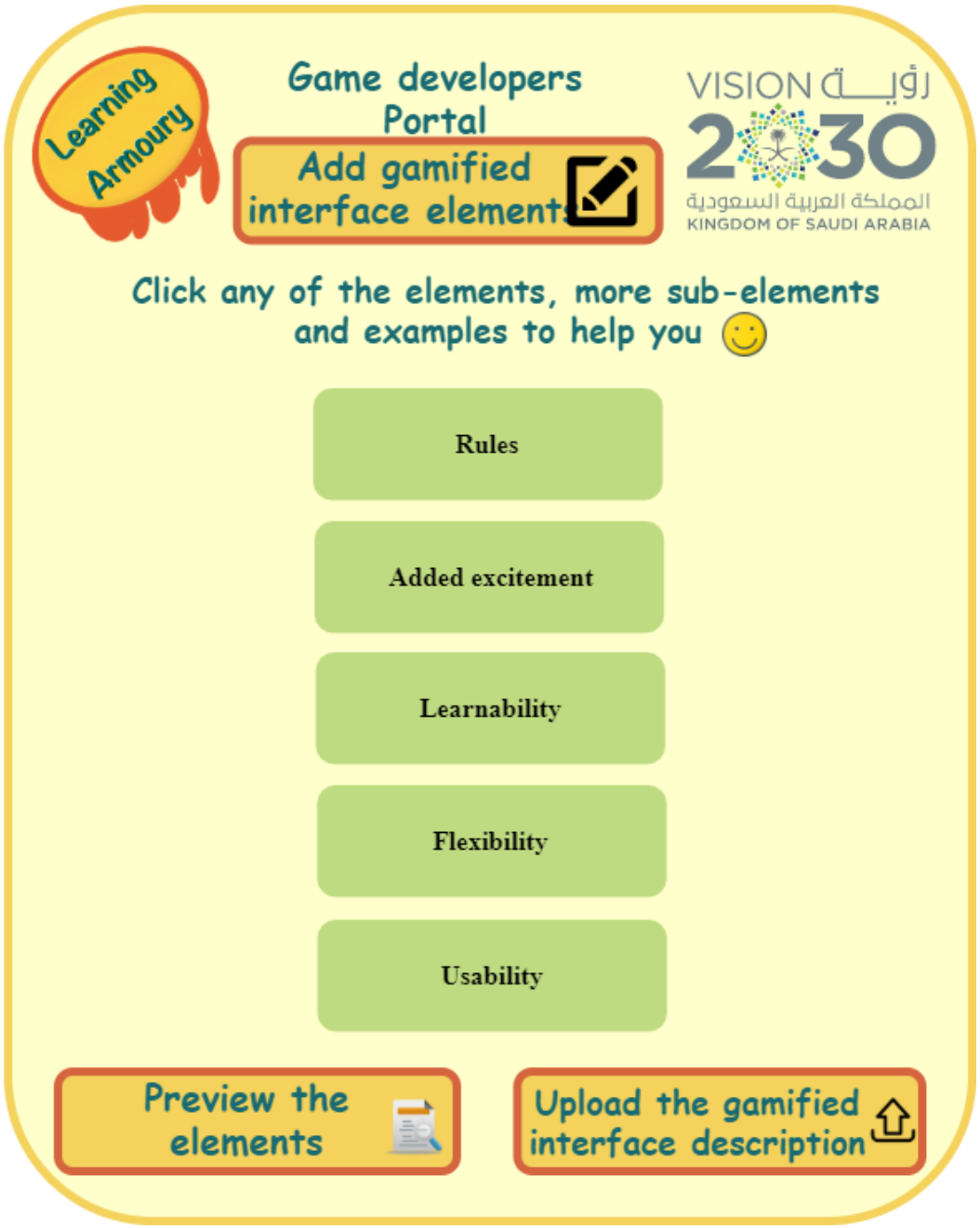
هل هناك أي تعليق أو اقتراح على النموذج؟

Appendix G.2.The Presentation Explaining the Research Aim and the Interview Goal

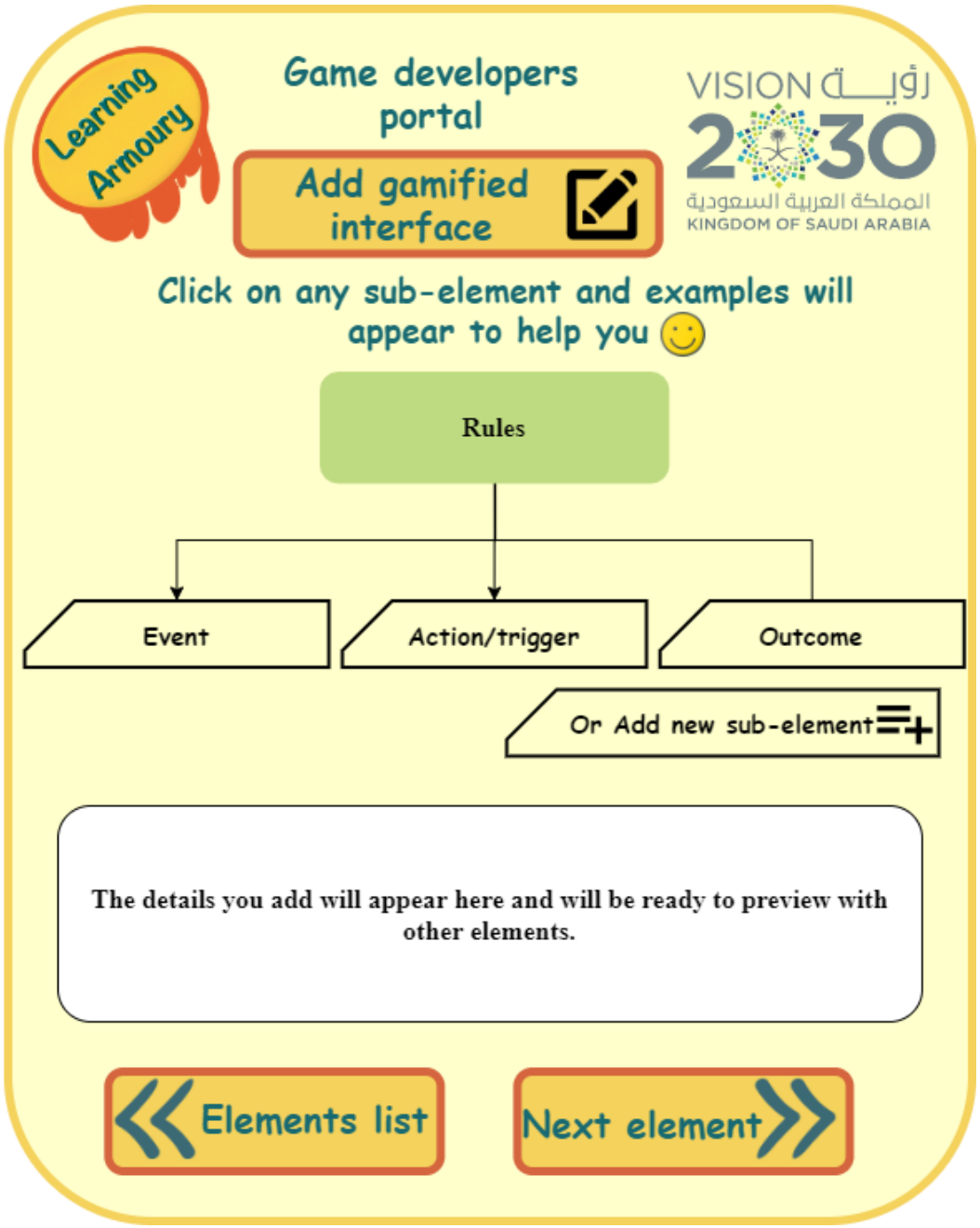
Appendix H. The Learning Armoury Interface

Learning Armoury Application Interface

Game Developers Main Interface



Game Developers Ped-GDD Elements Interface



Game Developers Ped-GDD Sub-elements Interface Example

Students Main Interface

Podcasts Interface