



**DEPARTMENT OF EDUCATION,
COMMUNICATION & LEARNING**

AN EXAMINATION OF FEEDBACK IN DIGITAL ENGLISH LANGUAGE LITERACY GAMES

Exploring students' experiences and teachers'
perspectives

Evangelia Ioannou

Thesis:	30 higher education credits
Program and/or course:	International Master's Programme in IT & Learning
Level:	Second Cycle
Semester/year:	Spring term 2018
Supervisor:	Wolmet Barendregt
Examiner:	Roger Säljö
Report no:	VT18-2920-003-PDA699

Abstract

Thesis:	30 higher education credits
Program and/or course:	International Master's Programme in IT & Learning
Level:	Second Cycle
Semester/year:	Spring term 2018
Supervisor:	Wolmet Barendregt
Examiner:	Roger Säljö
Report No:	VT18-2920-001-PDA699
Keywords:	feedback, literacy, games, students, teachers

- Purpose:** The aim of this study was to explore the students' experiences and English teachers' perspectives on feedback for errors provided in two digital English literacy games in the Greek primary education context.
- Theory:** The study employed a framework for the analysis of levels and dimensions of feedback originally by Hattie and Timperley (2007) and used by Benton, Vasalou, Berkling, Barendregt and Mavrikis (2018). This was further updated by looking at the studies of Johnson, Bailey and Van Buskirk (2017) and Narciss and Huth (2004). In addition, Activity Theory provided the basis for a method for analysis of observations as first presented by Pelletier and Oliver (2006).
- Method:** This study was carried out at a primary school at the suburbs of Athens in Greece. Participants were 18 students from the 4th and 5th grade and the school's two English teachers. Two digital English literacy games were used for this study, Reading Eggspress and Little Smart Planet. Data collection included game testing in pairs and observation of students' behavioural responses and interviews with teachers and students.
- Results:** Observations mainly showed that students noticed certain feedback, primarily Knowledge of Response (KR) and punishment (rejecting sounds, animated agents) and rewards. Students showed behaviour categorized as ignoring or no response to other feedback types, primarily delayed feedback in the Reading Eggspress mini-games and the KR and punishment of losing a life in both tested games. Interviews with students revealed that they focused on task-level feedback and on the Feed-back dimension, while some students would like Knowledge of Correct Response (KCR) feedback. Teachers often focused on the same levels and dimensions and they agreed with students as to what responses the feedback types cause. Teachers additionally elaborated on what types of feedback they would prefer the game to provide, mainly KR and hints, sometimes KCR, and why the feedback provided by the game enhances or impedes learning.

Table of content

1. Introduction	1
1.1 Feedback and learning.....	1
1.2 Feedback and cognitive processing	1
2. Background	3
2.1 Definitions of concepts.....	3
2.1.1 Game-based learning	3
2.1.2 Feedback.....	4
2.1.3 Feedback types	5
2.2 Previous research.....	6
2.3 Rationale for this study.....	8
2.4 Significance of the study	9
2.5 Aim and research questions.....	9
3. Theoretical framework for analysis.....	10
3.1 A method for data analysis based on Activity Theory	10
3.2 A framework for the examination of feedback in digital educational games	11
3.2.1 Levels of feedback.....	12
3.2.2 Dimensions of feedback	13
3.2.3 Types of feedback	13
3.2.4 Modality of feedback.....	13
4. Method	15
4.1 Design and setting of the study	15
4.2 Participants	15
4.2.1 Inclusion and exclusion criteria for participants.....	15
4.2.2 Participants' characteristics	16
4.3 Ethical considerations.....	17

4.4 Games.....	18
4.4.1 Reading Eggspress (RE).....	18
4.4.2 Little Smart Planet (LSP)	21
4.5 Data collection.....	22
4.6 Procedure.....	24
5. Analysis.....	26
5.1 First research question: Students’ behavioural response to feedback	26
5.2 Second and third research question: students’ and teachers’ opinions on feedback	27
6. Results	29
6.1 What are the students’ behavioural responses to the feedback they receive during gameplay? .	29
6.1.1 Students’ behaviour when noticing feedback.....	29
6.1.2 Feedback ignored by students	30
6.1.3 Feedback provided by the Community during gameplay.....	30
6.2 What are the students’ opinions about the feedback provided in the tested games in case of errors?.....	32
6.2.1 About observed feedback provided and response to it.....	32
6.2.2 Opinions about feedback beyond observed incidents and responses	33
6.3 What are the English teachers’ opinions about the feedback provided in the tested games in case of errors?	34
6.3.1 About observed feedback provided and response to it.....	34
6.3.2 Opinions about feedback beyond observed incidents and responses	35
7. Discussion	37
7.1 Summary of results.....	37
7.2 Discussion of results.....	38
7.2.1 Types and modality of feedback.....	38
7.2.2 Levels and dimensions of feedback.....	40
7.3 Limitations of the study.....	41
7.4 Suggestions for future research	42

Conclusion.....	43
Reference list.....	44
Appendix 1: Example of results from observations	46
Appendix 2: Opinions about observed feedback provided and response to it (students).....	49
Appendix 3: Opinions about feedback beyond observed incidents and responses (students).....	52
Appendix 4: Opinions about observed feedback provided and response to it (teachers).....	55
Appendix 5: Opinions about feedback beyond observed incidents and responses (teachers).....	59

1. Introduction

In recent years, digital or video games have become a useful tool in education with development of the market of such games growing (Benton, Vasalou, Berkling, Barendregt & Mavrikis, 2018). One of the school subjects with a great variety of games to use is literacy and especially English, as it is one of the most widely spoken languages in the world. One interesting topic for research in digital literacy games is the feedback provided, since feedback has been reported in literature to be one crucial factor not only for digital games, but also for learning in general.

1.1 Feedback and learning

In the educational context, feedback is considered a vital factor to an individual's learning. It is vital in acquiring and improving knowledge and skills (Hattie & Yates, 2014; Shute, 2008), as it helps the learner to assess "his or her progress and responses, identify knowledge gaps, and repair faulty knowledge" (Johnson, Bailey & Van Buskirk, 2017, p. 121). Additionally, it can contribute significantly to motivation for learning (Shute, 2008). Ideally, feedback in education should inform and guide the learner as to the next steps to be followed (Hattie & Yates, 2014).

In digital learning environments, as in traditional education, feedback is crucial to supporting the learning processes so that they are efficient (Narciss & Huth, 2004). According to Prensky (2001), feedback in a game is where learning happens. Essentially, the player receives the message either of being rewarded for achieving a goal or the message of failing, thus they need to try again until they do it right or ask for help.

1.2 Feedback and cognitive processing

In order to understand how feedback supports learning processes, it is useful to look at the cognitive theory of multimedia learning (CTML) explaining how learning occurs (Johnson et al., 2017; Mayer, 2014a; Mayer, 2014b). According to this theory, people process information through two distinct channels, the visual and the verbal channel, which can support a limited amount of cognitive processing at a time. Therefore, high demands on the learner's cognitive processing in one channel can cause it to overload. In the case of a digital game, learners participate actively in a learning episode through cognitive processes. Learners pick significant information from the game they play, organize it into a meaningful mental representation, and update this both with new information and with previous knowledge stored in long-term memory.

During a learning episode, the CTML suggests that the learner's cognitive system goes through three levels of processing (Johnson et al., 2017; Mayer, 2014a; Mayer, 2014b). The first level is extraneous processing that occurs if game design or instruction is weak and does not support the overarching educational goal of the educational game. The second level is essential processing, which results from the material's complexity and it is necessary to create a mental representation of the information being learned in the working memory. The third level, generative processing, is related to understanding the essential information presented to the learner in the game, restructuring it and connecting it to previous knowledge (Johnson et al., 2017; Mayer, 2014a; Mayer, 2014b). These three levels have an additive effect, meaning that if the first level demands a great amount of cognitive processes, the learner will not have the cognitive means to engage in the productive second and third level of processing (Johnson et al., 2017).

2. Background

2.1 Definitions of concepts

In this first section of the study's background, definitions and explanations of two important concepts in the study will be provided, namely game-based learning and feedback.

2.1.1 Game-based learning

Game-based learning is a kind of play with clear learning outcomes. Consequently, designing digital or non-digital games for learning implies that both the subject matter should be covered and game play should be prioritized (Plass, Homer & Kinzer, 2015). An important characteristic of game-based learning is fun, in other words enjoyment or pleasure, which sets our mind in a relaxed and accepting state for learning (Prensky, 2001). On top of providing pleasure, playing games increases one's engagement, which also contributes to learning (Prensky, 2001).

Digital games can provide “a meaningful social and epistemological experience that children can control at their own pace” (Hodent, 2014, p.149). Especially in the educational genre, it is important that the game is usable and it provides flow, meaning that it is not too easy nor too hard, and that it is enjoyable (Hodent, 2014). Therefore, it is important to consider user experience when designing educational digital games, in other words to design considering the end user's needs and feelings (Hodent, 2014). One of the elements that shape the game experience is feedback. In digital games this is immediate and ongoing, providing continuous evaluation that players expect and appreciate (Lieberman, Biely, Thai & Peinado, 2014).

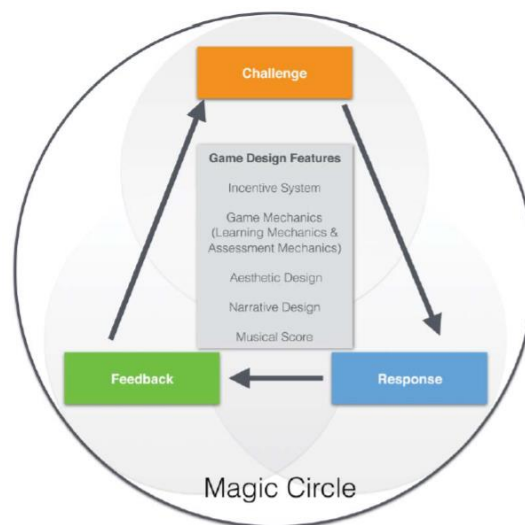


Figure 1. A model of (digital) game-based learning (Plass et al., 2015, p.262)

Plass et al. (2015) propose a model of game-based learning, also applicable to digital games, which includes feedback. This model comprises three basic components, namely challenge, response, and feedback (Figure 1), which create an iterative process, a magic circle. Specifically, players confront an initial challenge, they provide a response, they receive feedback on their response which poses a new challenge or indicates that the player should give a different response and the circle repeats. As Lieberman et al. (2014) phrase it, player input in digital games affects and interacts with the game, thus shaping the game state. In the centre of the magic circle are the game-design features which are present and affect the whole process. These are the incentive system (the elements to motivate players), the game mechanics (the activities the game requires players to repeat), the aesthetic design (visual design and representation of information), the narrative design (the game's storyline) and the musical score (musical background and sounds to signal important moments in the game) (Plass et al., 2015).

2.1.2 Feedback

Feedback is information delivered by an agent, like a teacher, peers, or books, directed to features of a learner's performance or understanding (Hattie & Timperley, 2007). This information permits the learner to fill the gap between current evidence and the correct or ideal situation (Hattie & Yates, 2014). More specifically, through feedback the learner can "confirm, add to, overwrite, tune, or restructure information in memory, whether that information is domain knowledge, meta-cognitive knowledge, beliefs about self and tasks, or cognitive tactics and strategies" (Winne & Butler, 1994, p. 5740). In serious games, like educational games, and simulations, Johnson et al. (2017) report that feedback is provided in various ways and its aim is to enhance the players' or learners' performance, motivation, or learning outcomes.

Feedback within a learning context, in traditional teaching or in digital educational games, happens after initial instruction. As a consequence, it has an instructional value when it offers information about a specific task or learning process reducing the gap between what the learner understands and what it is aimed to help him or her understand (Hattie & Timperley, 2007). Therefore, the learners need to have some knowledge on a specific topic or within a specific learning context in order to relate the new knowledge, provided by feedback, to what is already known (Hattie & Timperley, 2007). When feedback presents information to transform thinking or behaviour in order to enhance learning, it is called formative feedback (Shute, 2008). Especially video games can deliver dynamic assessment and individualized support, where feedback gives the learner a chance to reflect, retry and learn from errors (Lieberman et al., 2014).

2.1.3 Feedback types

Feedback can be delivered in various ways regarding the amount of information it provides and its content, as well as its timing. In addition, feedback may involve providing rewards and punishments for the learner's performance.

Commonly studied feedback types regarding amount and content of information are outcome and elaborative or explanatory feedback (Benton et al., 2018; Hattie & Timperley, 2007; Johnson et al., 2017; Narciss & Huth, 2004). Outcome feedback includes information about the outcome of the learner's performance (Johnson et al., 2017). In this category, broadly examined subtypes of feedback are Knowledge of Response (KR), Knowledge of Correct Response (KCR) and Answer Until Correct (AUC) (Narciss & Huth, 2004). KR means that the learner is informed only about whether his answer is correct or wrong, KCR means that the learner is additionally informed about what the correct answer is and AUC means that the learner is provided with KR feedback and gets to try again on the same or similar item. On the other hand, elaborative feedback is usually KR combined with additional information. Such additional information may include hints about useful strategies and sources of information, explanation why a response is correct or incorrect and location and type of errors (Narciss & Huth, 2004). Specifically, elaborative feedback can be further divided into three categories. It may be response-specific, when it explains why one answer is right and the other one wrong, topic-specific with information about the question or topic leading through the correct answer, or it can be hints, prompts and worked out examples (Johnson et al., 2017). This kind of feedback has also been referred to as process feedback because it guides the learner's processes to reaching a correct answer (Johnson et al., 2017) but it will be only referred to as elaborative feedback in this study.

Depending on the time when it is provided, feedback is commonly distinguished in immediate or delayed. Nevertheless, these terms are defined differently across studies (Attali & Van der Kleij, 2017). According to Shute (2008), immediate feedback is provided right after the student's response, whereas the definition of delayed feedback is relative to immediate feedback. Delayed is therefore provided some time after the student has responded, from minutes to weeks or even longer after the student's response (Shute, 2008).

In addition, games sometimes provide rewards and punishments to the players. Rewards are an expression of achievement-focused praise, which means that rewards are provided as praise to the child for achieving a goal. In addition, games sometimes provide punishment, which can mean temporary or complete removal of rewards (Benton et al., 2018).

2.2 Previous research

When examining feedback, a significant amount of research has focused on what effects different types of feedback have on learning when it is provided in digital educational games and other educational software. Van der Kleij, Feskens and Eggen (2015) did a meta-analysis of 40 different empirical studies in order to identify effects of the type of item-based feedback and its timing on students' higher- and lower-order learning outcomes. With lower-order outcomes they meant students being able to recall, recognize, and understand concepts without the need to apply this knowledge. With higher order learning outcomes, they meant students being able to apply their acquired knowledge in new situations. All of the studies they reviewed included an experimental group working with elaborative feedback and in some cases there was a control group working with KR or KCR feedback, while feedback for both groups in each study had the same timing, meaning either immediate or delayed. Their results showed that elaborative feedback (EF) had larger effects sizes than KR and KCR, although the value of EF over KR or KCR is more significant for higher order learning outcomes than for lower order learning outcomes. Effect sizes were generally larger for mathematics than for social sciences, science, and languages. Feedback timing also affected results, meaning that when it was provided with delay rather than immediately, it influenced the effect sizes negatively.

Certain studies have been conducted to investigate effects of feedback on learning in digital forms of practice tests. In this category, Attali and Van der Kleij (2017) examined how correctly participants would answer a test item, depending on feedback type (KCR or KCR with EF) and timing (immediate after each item or delayed after completing the whole test). The study employed a pre-test/post-test design and participants were randomly assigned to an experimental testing condition where they took one to seven mathematics web-based practice tests. They could decide to see an overview of the items, their answers, the correct answers and elaborated explanation in the EF condition. Results showed that, after participants' incorrect first response, EF resulted in better performance than KCR, but not after correct first response. Immediate feedback alone resulted in lower performance than when it was combined with the delayed overview. Narciss et al. (2014) aimed to investigate the connection between student characteristics, mainly gender, and how feedback messages affect learning and motivation. A pre-test/ treatment/ post-test design was used and results indicated that gender actually affects the influence of feedback on learning and motivation. Both these studies (Attali & Van der Kleij, 2017; Narciss et al., 2014) thus employed a similar design to observe participants' behaviour and measure effects on learning and, but without examining the participants' views on feedback.

Other studies have investigated types of feedback in more interactive digital learning environments. Law and Chen (2016) aimed to examine two types of question prompts separately as

well as their interaction with KCR and EF. With question prompts they meant questions within the game to help the learner focus on specific tasks, to articulate their thoughts, and to reflect on their learning processes. They distinguished two types of prompts, namely knowledge prompts that provided a series of step-by-step actions and decisions that resulted in the achievement of a task, and application prompts that required students to use a concept in a new situation and apply what was learned in the game to novel situations. Students from a secondary school in Taiwan were assigned to one of four groups with different combination of prompts and feedback. The researchers used pre- and post- tests to evaluate students' understanding as a result of the prompts and feedback they received and Likert scale questionnaires to assess their cognitive load, engagement and perceived ability. Results showed that EF lead to better student performance together with knowledge prompts, whereas KCR lead to better student performance when application prompts were given.

In another study about types of feedback, Lin, Atkinson, Christopherson, Joseph and Harrison (2013) investigated effects of different types of feedback, but at the same time investigated whether the presence of an animated agent makes a difference. More specifically, they examined the effect of the presence versus absence of an animated agent and the combination of these conditions with KCR feedback versus EF on learning, motivation and cognitive load in a digital science learning environment. Participants were assigned to one of four experimental conditions and the method of pre-test and post-test was used to identify how performance changed. In addition, a Likert-type questionnaire was used to measure cognitive load and assess motivation. The study's results showed that the presence or absence of the animated agent did not have a significant effect on learning outcomes or perceived motivation.

De Vries, Cucchiarini, Bodnar, Strik and Van Hout (2015) analysed feedback effects of an Automatic Speech Recognition (ASR) system for speaking practice. The authors were interested in the effects of the system providing speaking practice with KCR feedback or no KCR feedback on the students' performance. The design of the study was experimental with treatment (KCR) and control (no KCR) group. The no KCR condition meant that the group in this condition received the same message whether their answer was right or wrong. The message informed the participants that their answer had been saved and asked whether they wanted to move on or try again. The methods used were pre-test, post-test, logging participants' activity and Likert-scale questionnaires for overall evaluation. The result was that there was no significant difference in learning whether the participants received KCR feedback or no feedback, although participants in the experimental group who received KCR feedback evaluated the system more positively than the control group.

In the studies described above (Attali & Van der Kleij, 2017; De Vries et al., 2015; Kleij et al., 2015; Law & Chen, 2016; Lin et al., 2013; Van der Narciss et al., 2014), a pre-test/ post-test design

was also used, although the researchers also tried to examine the participants' opinions through Likert-scale questionnaires. However, in these cases the questionnaires were focused on an evaluation of the whole system, or how motivation was affected by the whole system. Therefore questionnaires in these studies did not focus on feedback provided and the participants' experiences from this feedback.

Some studies have aimed to look into feedback in education from the participants' perspectives, namely teachers and students. Tunstall and Gipps (1996) examined feedback provided by teachers through classroom recordings and observations, teacher interviews, student interviews, and analysis of written feedback in students' work. Based on the results of their data collection, the researchers developed a typology of feedback that teachers provide in their classroom. This included the categories rewarding or punishing, approving or disapproving, the teacher specifying successful achievement or areas for improvement, and discussing with the child to specify goals or future possibilities for learning. All these categories include more specific subcategories and examples of the feedback teachers provide to students. For instance, the category approving or disapproving includes verbal and non-verbal forms of feedback, while specifying achievement or areas for improvement included specification of teacher's success criteria or teacher's expectations respectively.

Hargreaves (2013) aimed to explore children's experiences of teacher feedback in the naturalistic classroom setting. The researcher observed and video recorded nine children aged 9 and 10 years old and interviewed them later that day so that they could comment on critical incidents of feedback. The main results were that children appreciated cues and prompts more than excessively directive feedback, while they could identify when the negative and positive feelings provoked by teacher's feedback would enhance or impede learning.

2.3 Rationale for this study

It is evident from the literature that feedback constitutes an important part of learning. However, when it comes to digital educational games, research has often focused on examining learning outcomes of feedback through pre- and post-tests. On some occasions, the students have been more involved by answering questionnaires about how the new system helped them in their performance or increased their motivation, but not specifically about how feedback helped them or not. Nevertheless, when examining digital educational games, user experience is particularly important, and there should be more research investigating students' responses to and opinions on feedback they receive from the game. As Hargreaves (2013) highlights, "the child's perspective on feedback is frequently missing from research into feedback" (p. 229) while current feedback studies usually focus on the feedback provided on the child's achievement, "rather than on how the individual child responds to the teacher's feedback within the feedback interaction" (Hargreaves, 2013, p. 230).

Furthermore, in order to obtain a more complete picture of how feedback is perceived in an educational context, it would be useful to study the trained educators' perspectives, meaning the opinions of teachers in a Primary school. This is because teachers have received an appropriate education on learning and, consequently, how to provide feedback which is enriched by the experience they have teaching in a classroom. Therefore, their opinions are expected to provide a deeper understanding of the feedback provided by digital games, especially when compared to the students' opinions.

2.4 Significance of the study

This study intends to fill a gap in the reviewed literature by examining feedback in digital English literacy games from the perspective of students and teachers, rather than exclusively through tests where the end users' experiences and perspectives are not reflected. In addition, this study aims to contribute to the development of the iRead project which is financed by the EU as an Innovation Action under Horizon 2020. The aim of the project is to develop a novel language learning technology focusing on reading with "personalised learning applications and teaching tools for formative assessment" (<https://iread-project.eu/about/>).

2.5 Aim and research questions

The aim of this study is to explore the students' experiences and English teachers' perspectives on feedback for errors provided in two digital English literacy games in the Greek primary education context. This study intends to answer the following research questions:

1. What are the students' behavioural responses to the feedback they receive during game play?
2. What are the students' opinions about the feedback they receive in case of errors?
3. What are the English teachers' opinions about the feedback provided in case of errors?

3. Theoretical framework for analysis

3.1 A method for data analysis based on Activity Theory

First, it was important in this study to identify a method which would help organize and analyze data collected from observations to answer the first research question. In this section, a method for analyzing data from observations based on Activity Theory is presented, created by Pelletier and Oliver (2006). In its basic form, Activity theory suggests that deliberate human action is mediated by a tool either as an object or in a conceptual form. Within this system, the acting person is a Subject, their objective or purpose is the Object and the mediating tool is the Tool (Pelletier & Oliver, 2006). The expanded form of the theory includes the Community where activity happens, the Rules existing in the community and Division of Labour in order to achieve the Object. Furthermore, contradictions, meaning system’s inconsistencies, can appear. Contradictions usually indicate that regular practice has failed (Pelletier & Oliver, 2006). This can be due to technical issues, to disagreement within the Community, to confusion in Division of Labour or to issues regarding the Object. “Such contradictions suggest that the system is somehow inadequate and needs to be improved through some kind of transformation or development (Pelletier & Oliver, 2006, p. 70)”. Building on these important components of Activity Theory, Pelletier and Oliver (2006) created a tool (figure 2) for data analysis that can be used for observations about learning from games. In this table, “Activity” is synonym to the concept of the Object, Actions are the actions towards achieving the Activity (Object) and Operation means the sub-actions taken towards the action. The Rationale provides an explanation of the contradiction, and Evidence of learning indicates if the contradiction was resolved, thus resulting in learning.

Activity	Action	Operation	Contradiction between...		Rationale	Evidence of learning (resolution)

Figure 2. A tool for data analysis of observations regarding learning from games by Pelletier and Oliver (2006, p. 74).

3.2 A framework for the examination of feedback in digital educational games

The intention of this section is to describe a framework that can be used for categorizing and examining feedback in digital educational games, including literacy games, when users are involved (Table 1). This framework will be used to answer the second and third research question. This framework is built on the original framework by Hattie and Timperley (2007), who introduced the concepts of levels and dimensions in feedback, and the work by Benton et al. (2018) who used the original framework while also focusing on feedback types, for a detailed examination of feedback in digital literacy games.

Table 1. A framework for the examination of feedback in digital educational games involving users.

Categories	Subcategories					
Levels of feedback	<u>Task level</u>	<u>Process level</u>	<u>Self-regulation level</u>	<u>Self-level</u>		
Dimensions	<u>Feed-up</u> ("Where am I going?")	<u>Feed-forward</u> ("Where to next?")	<u>Feed-back</u> ("How am I going?")			
Types	<u>Outcome feedback</u> KR= Knowledge of response KCR= Knowledge of correct response AUC= Answer until correct	<u>Elaborative feedback</u> (topic specific, response specific, hints/prompts)	<u>Immediate</u>	<u>Delayed</u>	<u>Rewards</u>	<u>Punishments</u>
Modality	Audio	Text	Video	Animated agents	<i>(Categories can be added or changed depending on the studied learning situation)</i>	
Suggestion or Observation	Suggestion (S)	Observation (O)				
User's attitude	Positive (enthusiastic, contented)	Negative (disappointed, confused)	Neutral (acknowledging, uncertain)			

The framework presented here will also include types of feedback present in the different levels and dimensions, while Johnson et al. (2017) and Narciss and Huth (2004) provide further insight into types of feedback and more specific sub-categories for this category as previously described in section 2.1.3. In this study, the framework was additionally informed by two more categories, since the aim is to examine participants' experiences and perspectives. One of these categories was users' attitude to feedback aspects, which could be positive, negative or neutral. The other category was "suggestion or observation", in other words if there is something suggested or observed about feedback.

3.2.1 Levels of feedback

Hattie and Timperley (2007) identify four different levels of feedback focus that can be also connect to the levels of processing in the CTML. First, task-level feedback has a corrective function and provides information about how well the task has been performed. It supports learning on a surface level when it comes to acquiring, storing, reproducing and using knowledge (Hattie & Timperley, 2007; Benton et al., 2018). It can probably be related and lead to extraneous processing, the first level of processing information, because it provides surface information rather than deep understanding. However, if the task-level feedback provided helps the learner create a mental representation of the information, then it could also lead to essential processing.

Second, process-level feedback is linked to the core task processes and to extension of the processes to other tasks. It aims to learning on a deeper level related to identifying and understanding relationships, as well as transferring knowledge to another context (Hattie & Timperley, 2007; Benton et al., 2018). Therefore, this levels aims to support, first, essential processing where the learner creates mental representations of the information, but also to generative processing where the learner restructures new information and connects it to previous knowledge, thus transferring knowledge to a new learning situation.

The third level of feedback is the self-regulation level, which is intended to help students monitor and regulate their own learning strategies related to feedback (Benton et al., 2018). This level of feedback, then, aims to provide the learner with higher learning abilities. For this reason it can also be connected to the second and third level of information processing, essential and generative processing respectively, because these are the levels related to deeper understanding and transfer of knowledge.

The last level Hattie and Timperley (2007) include in their framework is self-level feedback. This level is often present in learning situations, even though there is empirical evidence that it is not effective for learning (reference). Self-level feedback focuses on the learner's personal characteristics (Hattie & Timperley, 2007; Benton et al., 2018) and it conveys positive or negative evaluations or

even sympathy about the students. It hardly ever includes information about the task, therefore it seldom contributes to motivation, self-efficacy or comprehension about the task (Hattei & Timperley, 2007).

3.2.2 Dimensions of feedback

The three dimensions of feedback relate to important questions that need to be asked every time feedback is provided to the learners (Hattie & Timperley, 2007). The first question to be asked is “Where am I going?” and it is connected to the dimension of Feed up. This dimension is about providing information to the students and teachers regarding the achievement of learning goals (Hattie & Timperley, 2007). Benton et al. (2018) mention about this dimension that there should be a clear definition of goals and success criteria. It can be inferred that instruction as teaching is also included in this dimension because it proceeds feed-back and feed-forward and it is often necessary for goal setting in education. The next questions is “How am I going?” and it is related to the Feed-back dimension. In order to answer this question an agent is required, like a teacher, a peer, or one’s self, who gives information about the task or the learners’ performance “often in relation to some expected standard, to prior performance, and/or to success or failure on a specific part of the task.” (Hattie & Timperley, 2007, p. 89). Finally, there is the Feed forward dimension answering the question of “Where to next?”. In this dimension, the feedback given includes information that can result in superior learning (Hattei & Timperlei, 2007) and it involves scaffolding and direction to the learner (Benton et al., 2018).

3.2.3 Types of feedback

Types of feedback as described in section 2.1.3 will inform this category in our framework for feedback examination. In short, the content of feedback can be Outcome, including KR (Knowledge of Response), KCR (Knowledge of Correct Response) and AUC (Answer Until Correct), or it can be Elaborative (EF), including response-specific, topic-specific and hints or prompts. Depending on timing, feedback is either immediate or delayed, and types of feedback also include rewards and punishments.

3.2.4 Modality of feedback

Furthermore, in the case of digital games, feedback can be provided in different modes which are worth being included in a feedback examination since the modality of providing feedback can greatly affect how effective it is (Johnson et al., 2017). Feedback messages can be presented to the learner in various ways, for example in text form or through a multimedia form, like audio, video, or through animated agents. Each of these forms, and their different combinations, influences the learner’s working memory, thus they can affect learning through digital games. Specifically, when the

task is mainly visual, as in digital literacy games, learning is more effective if feedback is presented in audio rather than in text taking into account that “the limited capacity of the visual channel is already occupied by visual information” (Johnson et al., 2017, p. 130). Even though the modality of feedback does not form a separate category in Hattie and Timperley’s (2007) framework, it will form a category in the current study’s framework because it is relevant to learning from feedback and it has the potential to shape users’ experience from the game.

4. Method

4.1 Design and setting of the study

This is a qualitative study that intends to identify teachers' perspectives as well as students' experiences when receiving feedback in digital games. More specifically, this thesis focuses on students' and teachers' responses to feedback in two different games for learning English, called Reading Eggspress and Little Smart Planet, which will be described in more detail later on. These games were chosen as materials for this study first because they are international, in other words they could be used in different countries. They are also practical to use on mobile devices and easily available, even though Reading Eggspress requires a subscription after the end of the trial period. The study involved students playing these games in a setting different from the normal classroom and interviews with the participants (students and teachers) after the play session.

The setting of the study was a primary school at the suburbs of Athens in Greece, which has grades 1 to 6. English is taught as a foreign language (EFL) for 2 hours a week from first grade, while the number of hours of teaching EFL per week increases in higher grades. The study with students and teachers took place in the ICT class when it was not occupied and in the events hall of the school, which was free more often.

4.2 Participants

4.2.1 Inclusion and exclusion criteria for participants

Regarding students in the study, all participants were students at the primary school where the study was done and they had to be in 4th or 5th grade in order to be included. In addition, students had to be identified by the school's English teachers as having Medium or High proficiency level in English. Students were excluded from the study if they were diagnosed with a learning disability or difficulty or they had to repeat the same grade in school because these conditions would suggest the need for further support and additional factors would have to be considered during the study. In addition, it was necessary to exclude students without informed consent from their parent or legal guardian, as this would be against the study's ethics. Last, students without or with very little knowledge of the English language could not participate in the study, since they would not be able to play any of the games during game testing sessions.

The school had only two English teachers, therefore it was decided to include both of them in the study without applying inclusion or exclusion criteria.

4.2.2 Participants' characteristics

Teachers: Both English teachers working at the school were included in the study. Teacher 1 is a female with 26 year experience teaching English, 21 years in public schools and 5 years in the private sector. She said that she likes using computer games in her lessons because it “makes learning easier for students”. Teacher 2 is also a female and has 24 year experience teaching English, 14 years in public schools and 10 in the private sector. She also said that she likes using computer games in her lessons because they are "interesting for students, thus useful for learning.”

Students: The study involved 18 primary school students who worked in pairs, thus in nine pairs. There were eight male and 10 female students from 9 to 11 years old. Out of the 18 students, 12 were identified with high-level proficiency in English and six were identified with medium-level proficiency. The first two pairs of students participated in the sessions on March 12, 2018, pairs 3, 4 and 5 participated in the sessions on March 13, 2018, and the last four pairs participated in the sessions on March 14, 2018. Characteristics of the students who participated in the study are presented below in table 2.

Table 2. Participants' characteristics (students)

Group	Student code	Grade	Gender	Age (years)	Level of English proficiency	Date of game testing and interview
1	1a	4	Male	9	High	12.03.2018
	1b	4	Female	10	Medium	12.03.2018
2	2a	4	Male	9	High	12.03.2018
	2b	4	Female	9	High	12.03.2018
3	3a	5	Female	11	Medium	13.03.2018
	3b	4	Male	9	High	13.03.2018
4	4a	4	Female	10	Medium	13.03.2018
	4b	4	Male	10	High	13.03.2018
5	5a	5	Male	11	High	13.03.2018
	5b	5	Female	11	High	13.03.2018
6	6a	4	Female	10	Medium	14.03.2018
	6b	5	Female	11	High	14.03.2018
7	7a	5	Male	11	Medium	14.03.2018
	7b	5	Female	10	High	14.03.2018
8	8a	5	Female	11	High	14.03.2018
	8b	5	Male	10	High	14.03.2018
9	9a	5	Female	10	Medium	14.03.2018
	9b	5	Male	10	High	14.03.2018

First, it was decided to include students from grades 4 and 5, therefore two classes in the school. There were 35 students in total, 17 from grade 4 and 18 from grade 5. After consulting English teacher 2 who teaches both classes, 5 students (4 from grade 4 and 1 from grade 5) were excluded because they are low-achieving in English and the teacher said they had too little knowledge in English to play any of the games. Therefore, 30 students received an informed consent for their guardian and themselves to sign. Out of these 30 students, 23 (10 from grade 4 and 13 from grade 5) brought the informed consent back signed by their parent or guardian and themselves. Two students from grade 4 and one from grade 5 withdrew before data collection saying that they had changed their mind. At this stage, 20 students (8 from grade 4 and 12 from grade 5) were included in the study. These students were organized in 10 groups of mixed ability by English teacher 2. However, two of the included students from grade 5 were absent the whole week of data collection, so finally game testing and interviews were done with 18 students (8 from grade 4 and 10 from grade 5). Nevertheless it was not always possible to have mixed ability groups and some groups ended up having two students of high proficiency.

4.3 Ethical considerations

In order to carry out this study, certain ethical considerations had to be taken into account. First, as child participants were involved, parents or guardians needed to give their informed consent. For this reason, these consents had to be signed by parents and be handed back to the researcher before the beginning of game testing and interviews. In addition, an adapted more simplified consent was handed to the students to sign. In the informed consent forms students and their parents were told about the purpose of the study and that the students would be audio recorded during the game testing and the interviews. Students were also reminded about the purpose of the study before the beginning of game testing and they were asked again if they were comfortable with being audio recorded or if they would like the researcher to only take notes. All participants, including teachers, were informed that their participation was voluntary and they could withdraw from the study at any point.

Last, it is important to mention that, at some points, the teachers were told the name of the student who experienced an error during game testing. This way, they would be able to provide personalized feedback. However, participant students and their parents had been notified about this possibility in the informed consent they were given. Furthermore, this was the only occasion that students' names were mentioned

4.4 Games

In this section, a description of the games that were used in the game testing sessions is provided.

4.4.1 Reading Eggspress (RE)

Reading Eggs is an online method for teaching children from 3 to 7 years old to read in English. Reading Eggspress (RE) is a continuation of Reading Eggs and is designed to help children aged 7 to 13 improve their spelling and their reading comprehension, as well as provide them with books to read (<https://readingeggspress.com/>). When the user logs in to their page, they can decide if they want to learn “English skills”, play in the “Stadium”, “Mall” or “Apartment”, if they want to go to the “Library” or “Trophy Room”, view their “Targets” or play “Arcade” (Figure 3).



Figure 3. Main screen of the player's personal page.

For this study, it was decided to have the student participants play the Easy Practice mode of three “Stadium” mini-games all of which consisted of two parts. Specifically, participants played the mini-games “Spelling”, “Vocabulary” and “Usage” (Figure 4).



Figure 4. In the easy practice mode of “Stadium”, the player chooses one of the four mini-games.

First was the Spelling mini game, in the first part of which the participants had to choose the correct spelling of a specific word displayed on the screen (Figure 5). There were two choices, one wrong and one correct. In the second part the participants had to choose between three words and this time to choose the incorrect spelling (Figure 6).

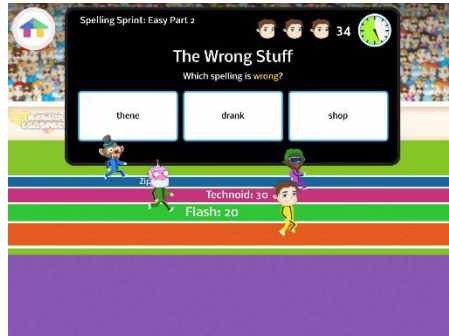


Figure 5. The “Stadium” Spelling game part 1: “The Right Stuff”



Figure 6. The “Stadium” Spelling game part 2: “The Wrong Stuff”

Vocabulary was the second mini game. In the first part of this mini game the participants/players were given a word and tasked to choose between two others the word that rhymes (Figure 7). In the second part they were given four options and they had to choose the word that did not rhyme with the rest (Figure 8).

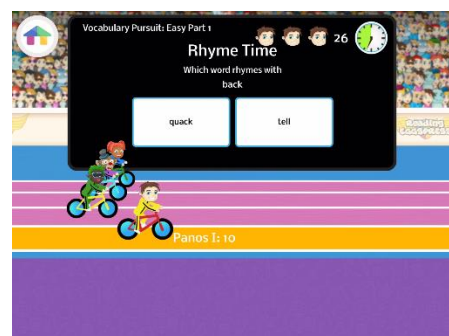


Figure 7. The “Stadium” Vocabulary game Part 1: “Rhyme Time”.

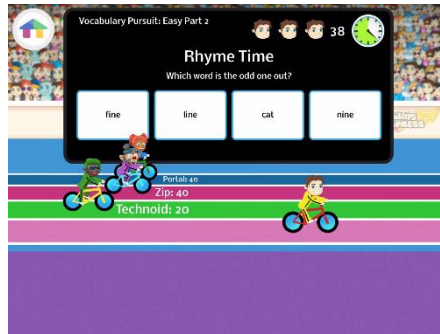


Figure 8. The “Stadium” Vocabulary game Part 2: “Rhyme time”.

Usage was the third and last mini game. In the first part of this mini game the participants were to choose between two sentences of which the one was correct and the other wrong (Figure 9). In the second part the participants had to complete a sentence given with a gap by choosing among four words (Figure 10).

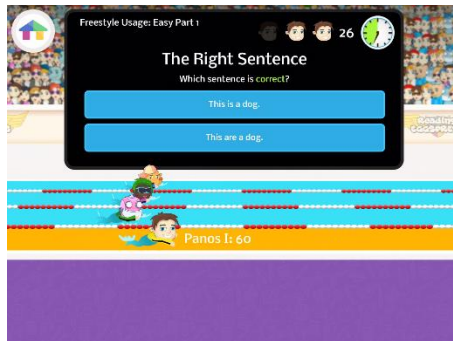


Figure 9. The “Stadium” Usage game Part 1: “The Right Sentence”

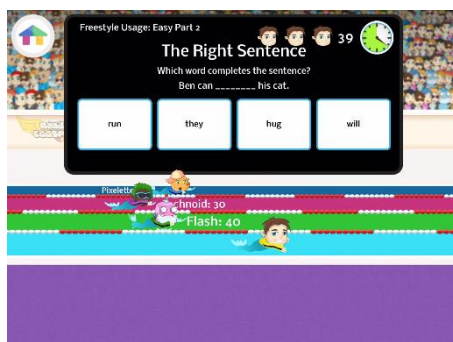


Figure 10. The “Stadium” Usage game Part 2: “Right Sentence”

4.4.2 Little Smart Planet (LSP)

Little Smart Planet (LSP) is a free online application that includes 54 games for children to practice and revise content taught in Primary school. The subjects it focuses on are Maths, Spanish and English (<http://www.littlesmartplanet.com/en/>). In this game the difficulty can be set by selecting the appropriate grade from the beginning (Figure 11). After selecting the grade, the player can choose among the subjects Mathematics, English and Spanish (Figure 12). After the researcher tried the “English” game for grades 1 to 6 in LSP, “English” for grade 5 was chosen as it was considered of a medium difficulty appropriate for both 4th and 5th grade in a Greek school. Then, the mini-game “Sentences in English” (Figure 13) was chosen to be played during game testing sessions because it requires a more advanced way of thinking than the other mini-games. It was also considered it might be later useful for comparison since it has a similar purpose to the “Usage” mini-game from RE which is trying to make correct sentences. In this “Sentences in English” mini-game participants’ task was to choose among three to four words to put in correct order in a sentence given above in order to complete it before time was up (Figure 14).



Figure 11. The player can choose the appropriate grade.



Figure 12. Then, the player chooses a subject.



Figure 13. The player chooses one of three mini-games.



Figure 14. The mini-game “Sentences in English” that participants played.

4.5 Data collection

Both games for the study were installed on an iPad 9.7, which all participants used in order to play the games. The iPad featured a screen recording system that allowed the researcher to save and process data later. This system recorded only the iPad screen and did not use any camera features.

The data collection procedures took place in March 2018. Each session with student pairs, including game testing and interview, lasted from 35 to 40 minutes. During game testing, the researcher also took notes of students' response to feedback that could not be recorded on the iPad or through audio recording. Selected parts of the screen recordings where students played the games were later edited into an iMovie with the purpose to use later with the interview with the teachers. The interview with teacher 1 was 15 minutes long and the interview with teacher 2 was 20 minutes long, in addition to three minutes before the interview where they only watched the compilation of students' errors. The researcher audio recorded the game testing sessions and the interviews with the students and teachers.

During interviews, students were asked questions about feedback in each of the two games, RE and LSP, and finally which of all games they liked more and if they had any suggestions about how these games would become better. The protocol included questions that could be answered in a few words, but students were encouraged to say as much as they could. The interview protocol for teachers included basic questions for discussion and follow-up questions for themes that needed to be discussed. Follow-up questions were asked either in case the teachers would not stop the researcher during the video or if the discussion went to a different direction than the aim of the study. Below are the interview protocols that were followed for interviews with students (table 3) and teachers (table 4).

Table 3. Interview protocol for students.

After each game (RE and LSP)
<ul style="list-style-type: none">• Do you feel like this game helped you move on when you made a mistake? Why or why not?• What feedback did you expect when you made a mistake? Why?• Do you feel that this game helped you move forward when you made a mistake? Why or why not?
At the end of the session
<ul style="list-style-type: none">• Which game did you like the most? Why?• Do you have any other comments or ideas about the games you played?

Table 4. Interview protocol for teachers.

1. Introductory questions

- How many years have you been teaching English? Both in a class and one-to-one.
- Are you interested in using digital games with your students for learning purposes? Have you used such games already? Why yes or why not?
- Do you feel like such games are helpful to teach English?

2. Show iMovie

Researcher plays each critical incident through once and then again asking the teacher to stop at the point the child experienced a problem.

3. Main questions

- What would you do to help the child address this error? (ask if the existing feedback would help here; if the researcher has intervened ask the teacher to comment on this intervention).
- How do you feel/ what do you think about the mode (audio, text, animated agents, etc.) in which feedback is provided in the games? Comments, suggestions for improvement?

4. Follow up questions (in case these issues are not mentioned by the teacher)

- Do you have some comments on the delayed feedback provided by the game after the end of the test/mini-game? (RE)
- Do you have any comments about the game in LSP where the correct answer is not given at all if the child makes a mistake? (Whereas in RE it is given in a table in the end)
- How do you feel about scaffolding/ providing help in case of errors?

4.6 Procedure

In this section, an overview of the procedures followed is presented (figure 15).

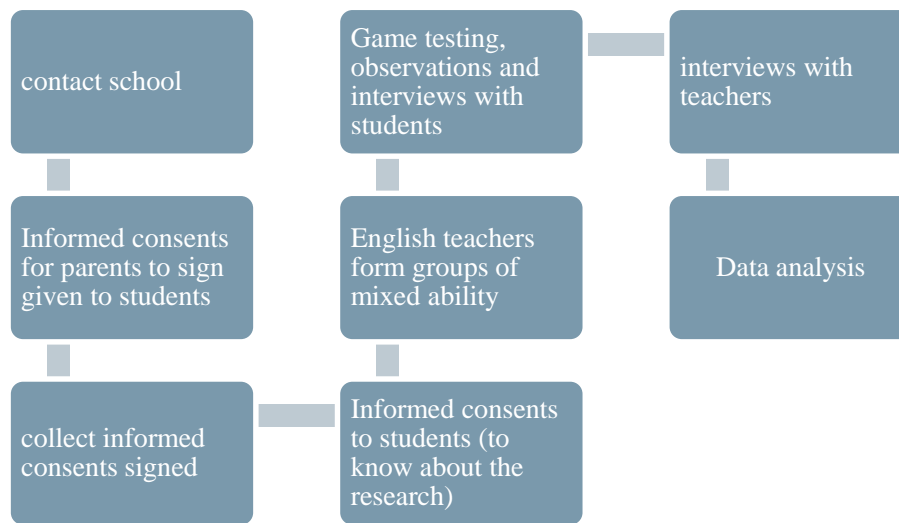


Figure 15. Overview of the procedures

The first steps in the procedure, as already described previously, included getting in touch with the school giving and collecting informed consents and the English teachers forming groups of mixed ability.

After that, the sessions with students were carried out and they consisted of two parts. At the beginning of the session, four mini-games were tested with students in pairs of mixed ability. Students in each pair took turns playing each game with the other student helping and providing feedback when he or she felt like it. The idea of having students work in pairs was, on one hand, to make them feel more comfortable in the presence of an unknown adult and, on the other hand, to encourage them to think aloud when talking to their partner. This way, more information could be provided about the students' thinking process.

During this game testing phase, the researcher also observed the students' behavioural responses and took notes on where students made mistakes and how they responded to feedback they received. The focus of the observations was on how students responded to feedback provided by the game and the researcher or their partner, what kind of feedback they paid attention to and what kind of feedback they appeared to ignore. Such observations were enriched when students thought aloud or when they talked with their partner.

After game testing each of the two main games (“RE” and “LSP”), the researcher did an interview with the students. The reason why it was decided to test after each of these two games was that all the mini-games of “RE” provided the same feedback. Therefore, it would cut the flow of gameplay and it would probably bore the students if we stopped after each mini-game to ask questions, whereas it was enough to interview them only once after the whole “RE” game.

When the sessions with all students were finished, the researcher re-watched all screen recordings and listened to audio recordings where it was noted that there had been critical or characteristic incidents of student error or interesting feedback incidents. Then, a compilation of critical or characteristic incidents was made into an iMovie which was used for the interviews with the teachers. Finally, interviews with the school’s two English teachers were carried out. First, the teachers watched the iMovie with the compilation of student errors. Then, a semi-structured interview followed where the teachers could stop the researcher at any point where a student had done a mistake and say their opinion about the feedback provided and how they would provide feedback.

For this specific study, it was expected that the students involved had been taught grammatical phenomena and vocabulary in the classroom similar to what was used in the games. Furthermore, the games they played were games for practice and they did not provide language instruction first, thus the Feed-up dimension in the study was mostly related to instructions on how to play the game. Therefore, the focus of this study during observations was to investigate how students responded to different types of feedback digital games provide in case of errors, in other words Feed-back, and how they responded to information about how to move on or recover for these errors, namely Feed-forward. On the other hand, Feed up (*Where am I going?*) as language instruction or educational goal setting was not examined during observations, nevertheless it could still be mentioned during interviews with students and teachers. The Feed-up aspect about goal setting and success criteria in relation to the game, and especially instructions on how to play the game, could be observed during game testing.

The last step in the process was data analysis which is described in detail in the next section.

5. Analysis

In order to perform the data analysis, screen recordings of game testing were watched again and student and teacher interviews were transcribed and translated from Greek to English. In question 1 it was intended to provide information on the students' behavioural responses to feedback using a method based on Activity Theory, focusing on types of feedback. The complete framework for analyzing feedback was used in the analysis of interviews in order to obtain a deeper insight into the responses observed. Thus, analyzing participants' opinions about feedback levels, dimensions, types and modality takes places in questions 2 and 3.

5.1 First research question: Students' behavioural response to feedback

For the first research question, I analysed the behaviour of students playing in pairs, and more specifically their response towards the game or the feedback from the Community, which in this case included the other student in the group and the researcher. I looked into the incidents of student errors that I had included in the iMovie that the teachers watched. These incidents were characteristic of student behaviour meaning that they were repeated across different groups. In addition, the analysis of student behaviour during gameplay is qualitative, in other words it focuses on what responses to feedback come up instead how often or how much.

After going back to watch the screen recording and listen to the audio recordings of group working, I used the table by Pelletier and Oliver (2006) for coding and structuring. Below is a further explanation of the categories in the table specifically for this study (table 5). It was decided to include a category "Researcher interpretation" additional to the original table in order to include additional notes about the incident which did not seem to fit in the other categories.

Table 5. A method for data analysis by Pelletier and Oliver (2006) adapted for this study.

Category	Category explanation
Grade	4 or 5
Time stamp	Time point of the observed action or operation
Student	Student code
Game name	
Activity	The mini-game goal/objective
Action (mechanic)	Actions the student takes to reach the game objective
Operation	Sub-action the student takes to complete the activity, sometimes automatically
Contradiction between	<u>Subject</u> (the user/ player), <u>Rules</u> (mechanics of the game or language issues), <u>Tool</u> (technical difficulties with using the materials)

Rationale	Further explanation of the contradiction
Evidence of learning (resolution)	If there is evidence that the contradiction was resolved, thus there was some kind of learning
Community	Interaction with the other student or with the researcher
Researcher interpretation	Researcher's notes about why or how the incident happened

5.2 Second and third research question: students' and teachers' opinions on feedback

For the second and third research question a qualitative content analysis of interviews was performed to find emerging themes about game feedback from students and teachers' interviews. Quotes in the interviews were coded and codes were categorized using the framework for examining feedback described in section 3.2. Table 6 provides a more detailed explanation for each category in this study. Although the approach was still qualitative, it was also intended to identify which feedback aspects are brought up more in the discussion and all interviews with students and teachers were analysed.

Regarding the last category, if the participant's quote was about something that they were suggesting that did not exist in the game, then it was considered a suggestion. If it was about something that exists in the game, including opinions about a feedback aspect existent in the game, it was coded as observation.

Table 6. Examination of feedback in two digital English literacy games involving users.

Categories/ themes for analysis	Sub-categories/ items identified in interviews					
	Levels of feedback	<u>Task level</u> Feedback directed to performance in the specific task or item	<u>Process level</u> more directly aimed at the processing of information, or learning processes requiring	<u>Self-regulation level</u> autonomy, self-control, self-direction; the way students monitor, direct, and regulate actions	<u>Self level</u> Feedback directed to one's self, personal attributes	

Categories/ themes for analysis	Sub-categories/ items identified in interviews					
Dimensions of feedback	<u>Feed-up</u> ("Where am I going?") Mention of educational goals/ objectives; also instruction, like teaching, or instructions/guide lines	<u>Feed-forward</u> ("Where to next?") When talking about how to move forward or how to go into deeper understanding	<u>Feed-back</u> ("How am I going?") Feedback on the students' progress, on their errors and correct answers			
Types of feedback	<u>Outcome feedback (KR, KCR or AUC)</u> KR= Knowledge of response KCR= Knowledge of correct response AUC= Answer until correct	<u>Elaborative feedback</u> (topic specific, response specific, hints/prompts)	<u>Immediate</u> Feedback after each item in the mini-game	<u>Delayed</u> Any feedback provided in the end of the mini game	<u>Rewards</u>	<u>Punishments</u>
Modality of feedback	<u>Audio</u>	<u>Text</u>	<u>Video</u>	<u>Animated agents</u> animated characters	<u>Colours/ highlighting</u>	<u>Symbols</u> Use of symbols (tick, cross, lines, spaces) or small pictures
Suggestion or observation	Suggestion (S)	Observation (O)				
User's attitude	Positive (enthusiastic, contented)	Negative (disappointed, confused)	Neutral (acknowledging, uncertain)			

6. Results

The results of data collection and analysis will be presented in this section according to the three research questions of the study.

6.1 What are the students' behavioural responses to the feedback they receive during gameplay?

A table with example results from the observations relevant to this research question can be found in Appendix 1.

6.1.1 Students' behaviour when noticing feedback

When students played the tested mini-games, it was observed that they paid attention, to a bigger or smaller degree, to certain types of feedback provided by the mini-games. This means that they showed obvious reactions like face expressions or talking aloud which led the researcher to observe their behavioural responses.

One characteristic behaviour consistent across most of the student groups was noticing the rejecting sounds, a type of punishment, in the game. In the case of student 1b in the spelling game, she noticed these sounds and that was how she knew there was an error. This was evident from her expression and what she said. However, it was clear that she kept answering the items randomly after this type of feedback. Student 8b was stressed or confused by these sounds as his reaction was to change his pace of reading and answering while his expression also showed that he got more stressed. However, stress was also caused by the timer of RE games which led students to answer more quickly and randomly, as it was clear in the cases of students 1b and 4a. In the case of other student groups it was not evident from the observations if they were stressed by the timer or another factor. Difficulty of content and not knowing the correct answer was another factor that led students to choose the wrong answer even though they were provided with feedback. Especially in the LSP game, students answered with a slower pace than in RE games and were not stressed by time, but they still answered wrong, like 2a and 4a.

Another type of feedback students noticed was anything related to the animated agents. More specifically, in the case of RE games, students paid attention to that their character stayed behind in the race when they made two mistakes or they took a long time to answer. This was for example the case for 2a, 4a and 8a who said aloud that their character was going slower or they started discussing it with their partner, like 8b. When playing LSP, the feedback element that grabbed students' attention in most groups was the animated agents falling from the windows when there was an error. Students 2a and 4a are a characteristic example of the students' behavioural response when seeing the animated agents falling, as they laughed and they said aloud that it was funny.

Regarding delayed feedback, in the RE mini-games the aspect that students seemed to notice more was their position in the end of the race which could be from 1st to 4th. Characteristically, student 4a pointed out the position in which she finished the game as soon as she finished the RE-U mini-game. In the LSP game, some of the students looked at the rewards they earned, namely stars and points. This was evident because they actually read how many points and stars they had earned, as in the case of student 4a.

6.1.2 Feedback ignored by students

On the contrary, there were certain types of feedback provided by the game which students appeared to ignore. The researcher categorized their behavioural response as ignoring when they did not look at this type of feedback or, even if they took a quick look, they did not show any reaction to it. Student groups appeared to ignore some delayed feedback provided in the RE mini-games which was especially evident with tables in the end of RE min-games containing correct and incorrect answers. In this case students would look away when these tables appeared and they either asked what the next game was, like student 2a in RE-U, or they started talking with their partner about something else, like student 1a in RE-SP. Student 4a was the exception as she read the final table with correct answers in the RE-U mini-game and tried to see what mistakes she had made and what the correct answers were. She was also the only student who evidently paid attention to the points she had earned by completing the whole mini-game. As mentioned already, the rest of the students did not look at the final screen of the RE mini-games which provided delayed feedback, including the reward of earning points.

Another type of feedback provided both by RE and LSP was the outcome (KR) and punishment of losing a life in the game every time the student made a mistake. Students did not evidently notice this punishment, except for students in group 2 who pointed out aloud that they had lost a life in the game.

6.1.3 Feedback provided by the Community during gameplay

During gameplay, feedback was not only provided by the digital game, but also by the community around the student, meaning, in this study, the other student in the group and the researcher. When there was interaction in the group, the student who was not playing usually gave prompts by proposing the correct answer and the other followed their partner's advice and clicked on this option. This happened for example when 1a was playing RE-SP, when 8b was playing the second part of RE-V and when 4a and 2a were playing the LSP game. There was not a case of contradiction between the student and the Community, where the partner would propose an answer and the student clicked on something else. In two groups there was not only prompting of the correct answer by the

partner, but the students had a short discussion about which answer is correct. Specifically, group 8 had this discussion when 8b was playing the first part of RE-Vocabulary and group 4 when 4a was playing the second part of RE-Usage game.

Furthermore, the researcher provided additional feedback on some occasions. What was common in all groups was that the researcher's Feed-up, meaning game instructions were read in English and translated to Greek when the first student of each group was playing each mini-game. In addition, the researcher also provided further explanation of the game's instructions when they clearly appeared to confuse the students. More precisely, the second part of the RE-Vocabulary game tricked student 9b when he was playing, as he was surprised when he saw that he had made a mistake. Then, the researcher explained to him the instructions again and as he still did not understand what he had to do, the researcher explained specifically what "odd" in the instructions meant. After that, the student was able to follow the instructions during the rest of the game.

Apart from that, hints were provided when considered necessary. For instance, when 2a was playing the first part of the RE-U mini-game, he said that both sentences looked the same. Then, the researcher read both sentences putting emphasis on the difference, the word "a", so that the student would notice it and she actually did. In the cases of having to complete a sentence, therefore the second part of RE-U and LSP, the researcher provided a type of hint reading the sentence aloud and stopping at the gaps in order to motivate students to think what was missing. This was done for the students who seemed quite confused by the game's instructions and did not know what to do. Nevertheless, there was no clear indication whether the students were helped by this kind of scaffolding.

Finally, the researcher encouraged the partner to help the student playing when he or she seemed to have some difficulty and there was no interaction in the group. She also encouraged students who were evidently stressed by different factors, like the timer or the rejecting sounds of the RE games. In other words, she emphasized that it is part of the process to make mistakes and she reminded students that the aim of this study is to understand what they think of the game feedback.

6.2 What are the students' opinions about the feedback provided in the tested games in case of errors?

6.2.1 About observed feedback provided and response to it

During interviews with the student groups, interviewees referred to certain aspects of feedback and responses that were also observed during the observations (see Appendix 2). Through the interviews they provided deeper insight into these observed aspects and behavioural responses.

First, students' quotes were about outcome feedback from the game, specifically knowledge of response (KR) outcome feedback. In this case, quotes were at the same time about the Feed-back dimension, in other words the game informed them how they were doing or how they had done. Group 1 and student 8b mentioned that, when they were wrong, game sounds confused and stressed them or that they were in general stressed when they saw they were wrong. On the other hand, students 2b, 3b, 4b, 5a, 5b and 9b neutrally stated that they would understand when they had made a mistake by seeing their character slowing down in the race for RE games or the animated agents falling from the windows for the LSP game. This was also the case for student 4a although she additionally mentioned that it was funny when these characters fell. Student 1b also thought that these characters were funny, but she did not clearly say if that is how she knew she was wrong. Finally, students 3b and 4a pointed out that they lost a life in the game when they were wrong. Specifically, student 3b was neutral towards this feedback type while student 4a was positive.

Continuing with the feed-back dimension but the immediate type of feedback, students 1b and 4a expressed the opinion that the fast pace of the game and the timer or countdown would make them stressed. On the other hand, delayed feedback in combination with rewards was brought up in the discussion by student 9b. He highlighted that "when we finished, the game would show us our score" referring to the final table of each RE mini-game showing the points students had gathered during the race.

While in the above cited cases students talked about the feed-back dimension, feed-forward was also mentioned. First, student 2b said that she answered the items randomly in order to move forward in case he did not know the correct answer. Second, students' 3b and 8b quotes are related to the self-regulated dimension of feedback within the feed-forward level. In other words, student 8b said he was able to move forward in the LSP game because the game gave him a kind of hint when it provided certain words that he needed to put in the sentence. Student 3b simply said he did not need help from the game to move on. Similarly, students 5b and 6a said they did not need any help when playing.

Finally, student 8a was negative about the game instructions at the beginning of the game which she characterized as too difficult. Therefore, she referred to the feed-up dimension of feedback which includes setting a goal and instructing or giving instructions.

6.2.2 Opinions about feedback beyond observed incidents and responses

Furthermore, certain issues were brought up during interviews with student groups about feedback or responses which were not observed during game testing (see Appendix 3). To begin with, there were a few students who expected to see KCR feedback, in other words the correct answer when they made a mistake. This was what student 2b and 8a said, whereas 1b suggested it would be nice if the correct answer was circled after a mistake and 1a suggested that the game would cross the wrong answers and tick the correct one. On the contrary, regarding outcome (KCR) feedback, students 2a and 2b focused on self-regulation since they mentioned they could figure out the correct response themselves when they received feedback that their answer was wrong.

Related to KR outcome feedback, student 6a noticed that clapping stopped that “the orange line would not appear when we made a mistake”, but she did not express any other feeling about that. Student 8a said she got confused when the animated agents in the LSP game fell off the window, while 4b expected something different in case of error, another type of punishment like that “the thing we threw water with would break” as he said. Student 4a mentioned a kind of outcome-AUC feedback, when she pointed out that she liked that there were three chances in the LSP game to find the correct answer. Her quote is related to self-regulation because she liked that she could try to answer correctly without help or other feedback from the game.

When students in group 1 were asked if the game feedback helped them to move on, they both said that game sounds in the RE game did not really help and they needed something more than sounds, more Feed-forward, in order to move on in the game. Student 1b suggested as Feed-forward the game giving a hint in the beginning, like showing how many letters are in the word you have to put in the sentence. However, her partner thought that this would be a way of the game actually providing the correct answer, which would thus be a way of KCR and feed-back rather than feed-forward.

Finally, student 3b mentioned that, in his opinion, the timer in both games was positive because it made him think faster, contrary to what was observed with students during game testing. Student 4a talked about the game content, specifically that the words of the LSP game were too hard and this stressed her. Although stress was observed at occasions during game testing, it could not be concluded if the game content difficulty stressed students, as it was not said aloud by anyone.

6.3 What are the English teachers' opinions about the feedback provided in the tested games in case of errors?

6.3.1 About observed feedback provided and response to it

During interviews, teachers discussed certain feedback provided and students' responses to it that were observed during game testing (see Appendix 4). The first topic that came up with teacher 1 was outcome (KR) feedback in RE games. The interviewee said that the audio feedback can make the game livelier but they could work either as rewards or as punishment. She further elaborated that they should not harm children's confidence, addressing a self-level feedback, and that praising sounds should be louder than the "rejecting" sounds. She addressed self-level feedback one more time by noting that the character staying behind in the race can also harm students' confidence.

During game testing the researcher's approach when students were having difficulty was to try to involve their partner to help, even by proposing the correct answer. Teacher 1 had a similar idea about involving the whole class to help find the correct answer when one student struggled to do it.

Regarding the RE-V game, when teacher 2 saw the iMovie with incidents from the second part of this game, she directly expressed her disapproval and made a point regarding the feed-up dimension and the process level of feedback. More specifically, she explained that the instructions of this game can confuse students and even if they get it right the first time, the game flow can distract them and they will probably choose the word that rhymes instead of the odd one.

Delayed feedback in RE games was another topic of discussion. Teacher 2 expressed the opinion that this type of feedback does not help students remember what was wrong and what was correct, and she thought it is a drawback that it is not elaborative. On the contrary, teacher 1 was positive to providing a table with the correct and incorrect answers that student gave when playing. As she quoted, "it is necessary that they get feedback in the end with the total of correct answers, like an overview".

When teachers were asked about feedback in the LSP game, they talked about outcome (KR) feedback mentioning that the bright colours and movement (teacher 1) and especially the animated agents (teacher 2) would help the student realize when his or her answer is wrong. In addition, they agreed on the game's outcome (KCR) feedback. In other words, teacher 1 said that students should see and hear the correct answer, as it is in the game when they are right, thus text and audio should be used. Teacher 2 had the same opinion that highlighting and reading aloud the correct answer is useful for students to remember the correct answer.

Finally, as it was also observed with a few students, teacher 2 suggested that the fast timer in RE games can stress and it can make even high achieving students answer fast and randomly.

6.3.2 Opinions about feedback beyond observed incidents and responses

On the other hand, when teachers were interviewed, they also brought some insights into the discussion that were beyond what was observed during game testing, including different perspectives on what was observed and suggestions about feedback (see Appendix 5).

First, the teachers discussed outcome (KCR) feedback, regarding both task and self-regulation level of feedback. More specifically, teacher 1 cited that, in the end, it is important that students remember and understand the correct answers, focusing on the task level of feedback, but she thought it does not make a difference that the correct answers are not presented after each item in the RE games. On the contrary, she said that students should think of the correct answer themselves, taking this time an approach to self-regulation level feedback. In opposition to teacher 1 opinion about immediate feedback, teacher 2 thought that it is better to show the correct answers during the race in the mini-games, while delayed feedback with answers can only be useful for students to keep track of their progress. Regarding this delayed feedback teacher 1 additionally mentioned that it is not important and it does not make a difference if the names of categories in the final are different in each RE mini-game, for example the category is named “incorrect spelling” in RE-SP and “your answer” in RE-V. Last, regarding outcome (KCR) feedback in the LSP game, teacher 2 thought that feedback in the LSP game should include animated agents, showing the correct answer in text and audio, meaning someone reading the sentence. She also suggested that the way correct words are highlighted and the sentence is read aloud, also seems like a reward. Unlike teacher 2, teacher 1 thought that the animated agents falling when the player is wrong but without providing outcome (KCR) feedback actually makes students think about what was the correct answer.

Next, the interviewed teachers brought up elaborative feedback to the discussion. Particularly, teacher 1 talked about hints and how it is better for students to give them hints to find the correct answer rather the correct answer directly. Teacher 2 focused more on explanations and examples, although it was not clear if she talked about topic-specific or response-specific feedback. She proposed that explanation and examples should be provided about common mistakes, as this is what she usually does in the classroom. Furthermore, she had an idea that the game could provide examples and explanations to the player after a specific number of mistakes.

Moreover, both interviewed teachers talked about feedback which can be provided only by a teacher or is better provided by the teacher than the game. More specifically, teacher 2 said that she usually repeat the student’s response as a question or makes facial expressions to help the student

understand his or her answer is wrong. She also said that explanations and examples should be provided by the teacher and the digital game cannot do it in the same way. Teacher 1 mentioned that the teacher can intervene when students play a digital English literacy game and give a hint to the correct answer when this is not done by the game. Finally, it was only teacher 2 who stressed the importance of language instruction first in order to practice a skill afterwards.

7. Discussion

First, a summary of the results is provided. Thereafter, a discussion of the results and the study's limitations will follow.

7.1 Summary of results

This study aimed to examine the students' experiences, including behavioural responses and opinions, and the teacher's perspectives on feedback in digital English literacy games. Results from the observations showed that students observed certain types of feedback, namely KR and punishment (rejecting sounds, animated agents) and rewards, while some kinds of feedback would cause them stress, like the timer in RE. On the contrary, appeared to ignore other types of feedback, namely delayed feedback in RE mini-games and the outcome (KR) and punishment of losing a life in both games. Moreover, there was additional feedback provided by the Community in that specific context, including prompting of the correct answer by the partner and explanation of the instructions (Feed-up) and hints by the researcher.

The picture about students' experiences from feedback was completed by interviews with students, which provided a deeper understanding regarding their experiences from different dimensions, levels, types and modalities. Interviews confirmed the observations about responses to the Outcome-KR feedback and the modality of providing it, and, in addition, some students expressed their needs for KCR or Elaborative feedback. Interviews also revealed what levels and dimensions students focused more on. They focused on task level but they also talked about self-regulation feedback, while the most prevalent dimension in the discussions was Feed-back and less often Feed-forward and Feed-up.

Moreover, interviews with teachers offered another insight on feedback, that of the experienced educator. Their quotes often reflected the students' opinions, meaning that they focused on the same levels and dimensions and they agreed with students as to what responses the feedback types cause. However, teachers additionally elaborated on what types of feedback they would prefer the game to provide, mainly KR and hints, sometimes KCR, and why the feedback provided by the game enhances or impedes learning.

7.2 Discussion of results

7.2.1 Types and modality of feedback

Regarding the type of feedback provided, the observations could only provide data about observable behavioural responses to feedback existing in the games, except when students thought aloud or talked to each other thus providing additional information.

The most prevalent type of feedback in the games was outcome-KR feedback and students were observed to understand it through the animated agents or the sounds of the game. The interviews with students supported this observation and provided a better understanding of the students' opinions, meaning in which cases KR caused a mere understanding that they had done a mistake and when it provoked stress or it was received positively. Teacher 1 agreed with some students' opinion that the sounds for KR made them stressed by saying that KR feedback as sounds in the RE games can harm or enhance confidence, while teacher 2 did not comment much on KR feedback in either game.

Outcome-KCR was only evident in the delayed feedback in RE and in LSP when the player was correct. The delayed KCR feedback was only noticed by one student in the RE games, whereas KCR feedback in LSP did not provoke any obvious response. In the interviews, it is underlined that most students who wanted the game to show or highlight the correct answer when they were wrong have a medium-level proficiency. On the other hand, only high-achieving students talked about KCR in terms of self-regulation, meaning they had their own strategy to identify the correct answer. The high-achieving students' point of view was also closer to the teachers who would prefer other feedback than KCR in case of errors. If these findings are interpreted from the point of view of the Magic Circle of game-based learning, high-achieving students' and teachers' opinions actually reflect that feedback should follow the response to a challenge while posing a new challenge or indicating that players should provide a different response (Plass et al., 2015). On the other hand, KCR feedback directly provides the correct answer (Hattie & Timperley, 2007; Benton et al., 2018; Johnson et al., 2017), hence it does not necessarily pose a new challenge for players and it does not allow them to try with another response. For medium- or low- achieving students this might mean feedback only on the task level without leading to an understanding of underlying processes or to self-regulation. In line with this idea, teacher 1 highlighted that it is good the game did not give KCR feedback, although it would also be positive to have some hints in the game but still without KCR.

Elaborative feedback could only be identified in the interviews and participants expressed different opinions about it. Some medium-achieving students preferred to get a hint from the game either from the beginning or after making a mistake. Teachers were also in favour of elaborative feedback, especially teacher 2 suggested more examples or explanations in case of mistakes. Results

from previous research support participants' preferences as they have shown that EF can have better outcomes for learning than KR or KCR feedback (Attali & Van der Kleij, 2017; Van der Kleij et al., 2015). Nevertheless, this also depends on other conditions, for example Van der Kleij et al. (2015) identified that KCR was more effective after correct response to the previous item, while Law and Chen (2016) found that KCR is more effective than EF when it follows application prompts. On the other hand, high-achieving students mainly quoted that they did not expect or need different feedback from the game, including KCR and EF. This could be possibly due to their high level of proficiency in English, but also to other factors like high level of self-regulation in learning. Teacher 2 had an interesting idea that the game could provide examples and explanations to the player after a specific number of mistakes. Since Hodent (2014) mentions that a game should not be too easy nor too hard, it could be actually useful to allow the student to try and figure out the correct answer before providing scaffolding but to provide EF at some point so that the game does not get too hard. It is also quite feasible to include this kind of feedback proposed by teacher 2 when developing a game.

Some types of feedback seemed to provoke stress especially because of the modality in which they were provided, namely sounds in the RE games, a type of KR and punishment, as well as seeing the timer running. This observation was confirmed during student interviews, except for one student who found it effective in that it made him think faster. Teacher 1 agreed that this would probably be the effect on all students, whereas teacher 2 partially agreed and thought that it depends on the student. If we go back to the Magic Circle of game-based learning (Plass et al., 2015), it is maintained that the parts of the iterative process (challenge, response, feedback) and their relation are what shape game-based learning. At the same time, game-design features, as musical background, like the game sounds, and in this case also a visual timer, are constantly present and affect the learning process (Plass et al., 2015). A characteristic of game-based learning is that it is enjoyable and pleasant and sets our mind in an appropriate state for learning (Prensky, 2001), while learners can learn at their own pace (Hodent, 2014). As a consequence, it can be said that when this characteristic is removed, it may have a negative effect on learning. However, there was an exception of a student mentioned above who liked getting "stressed" or having some pressure when learning. Hence this conclusion should be supported through further research on how students' level in English or other characteristics affect their preferences for the pressure they receive during gameplay.

During game testing sessions it was observed that students evidently paid attention to animated agents in both games, while for the LSP game students sometimes said aloud that they thought the characters were funny and laughed. During interviews, quite a few students mentioned that their character slowing down in the RE games helped them see they were wrong, as did the animated agents in LSP, which were also mentioned to be funny. The English teachers were also positive about the

feedback provided by these characters in the LSP game, and they thought that this would grab the students' attention and it would result in better learning. On the contrary, the study by Lin et al. (2013) found that the animated agent factor did not have significant main effects on learning outcomes measures or perceived motivation. However, the present study used interviews instead of a Likert-scale questionnaire and it is possible that it provided a deeper insight into users' perspectives about the use of animated agents. Additionally, the authors (Lin et al., 2013) themselves point out that existing research on the effects on animated agents on learning and motivation are inconclusive.

7.2.2 Levels and dimensions of feedback

The dominant level in the interviews was task-level feedback, both by students and by teachers, whether they made an observation or a suggestion about the game. This level of feedback is reported as aiming to a surface level of learning (Benton et al., 2018; Hattie & Timperley, 2007; Johnson et al., 2017) and can be mainly connected to the extraneous level of processing of information, which does not lead to deeper learning (Johnson et al., 2017; Mayer, 2014a, 2014b). It seems that students were mostly interested in receiving the necessary feedback to achieve the certain Object (the Activity) of the game rather than learning about the processes underneath the task. Similarly, the teachers focused on what feedback should be provided in order for the student to know and remember the correct answer rather than how he or she can learn the underlying rules. This focus of the participants can be interpreted as what their goals are when playing an educational game and possibly their goals in everyday education, specifically that they aim to a basic level of knowledge. Nevertheless, it should be taken into account that the interview protocol also included a few questions directed to task-level of feedback which may have contributed to the discussion in a way. The feedback provided by the games may have also lead the participants to talk more about this specific level.

Even though discussion was often about task-level feedback, it is interesting that students, both with high- and medium-level proficiency, talked about self-regulation either in relation to the Feedback or the Feed-forward dimension. In line with these students' opinions, only teacher 1 cited that it is important to let students think of the correct answer themselves enhancing their self-regulation without giving them outcome- KCR or even KR feedback. On the other hand, process-level feedback, which provides information about the underlying rules and processes of a task (Benton et al., 2018; Hattie & Timperley, 2007; Johnson et al., 2017) was almost never mentioned in the interviews. It could be only identified in one quote by teacher 2 related to the processes underlying the game or its instructions, thus related to the Feed-up dimension. Process-level feedback is very important because it aims to learning on a deeper level about identifying and understanding relationships, as well as transferring knowledge to another context (Benton et al., 2018; Hattie & Timperley, 2007). It can help towards essential and generative processing, the processing levels that lead to profound learning.

Consequently, the fact that this feedback level was not mentioned in the interviews could be worrying, as it could mean that it is not considered as important. This is not the only explanation though if one thinks that another important level, self-regulation, was still mentioned in the interviews. The reason could be also that the games played did not provide any process level feedback either, thus especially students might not have thought of receiving feedback about the rules behind the task.

Finally, self-level feedback was almost never mentioned in the discussions and the games tested did not include such feedback. The only exception was when teacher 1 suggested that the KR/punishment feedback in the RE mini-games could harm students' confidence. This is an encouraging finding because it shows that teachers understand students' needs for higher levels of feedback, students expect the same and digital English literacy games are designed around other levels of feedback. Literature also supports that self-level feedback has no instructional value since it rarely provides information about the task (Benton et al., 2018; Hattie & Timperley, 2007), let alone about processes and self-regulation. Although the teacher's quote was coded as on self-level feedback, which addresses the learner's personal attributes, it can be also regarded as the teacher's consideration about the students' motivation to play the game and learn. From this point of view, her opinion is related to engagement of the players which contributes to learning (Prensky, 2001).

7.3 Limitations of the study

Finally, it is necessary to discuss certain limitations of the study. First, one method used was observations of students' behavioural responses to game feedback which also involved the students thinking aloud. This was the reason they played in pairs, however most often they stayed silent and it was hard to have them talk to each other even by reminding them often. Since there was only one researcher observing students and they could not be filmed to show their response to another researcher, the observations of ignoring or noticing feedback might have been subjective at times. Nevertheless, the researcher tried to be as objective as possible by not categorizing their responses unless they were obvious, for example looking away from the screen without looking at the feedback would be seen as ignoring this feedback. Additionally, it was the same researcher who did the interviews. Then, there were incidents where high achieving students were taking over during gameplay or interview and the average student in the pair did not have many chances to participate. Furthermore, it can be said that a bigger number of teachers participants could have offered more data on the educators' perspective. The intention when including only the school's English teachers was to get the perspective of teachers who are familiar with the study's context that is the school, and the students participants. Last, it is acknowledged that data analysis could be improved as data was coded by one researcher while the framework for examining feedback was used only to answer the second and third research questions.

7.4 Suggestions for future research

First, since this study reviewed only two digital English literacy games, more and different games on the same subject should be tested with participants. In addition, testing digital games of other subjects like science could bring different results. Next, more teachers should be interviewed and more schools could be involved, so that the results are generalizable. Then, this study focused on participants' perspectives and this brought some interesting results in relation to literature on feedback and game-based learning. As Hodent (2014) mentions, user experience is very important when designing digital games. Therefore, more research should be done focusing on the perspective of the participants about feedback in games. Even quantitative studies mainly using tests or Likert-scale questionnaires can be enhanced by adding a qualitative perspective, for example interviews and focus groups. Last, it is essential to also look into naturalistic settings by using the games in the classroom during normal lessons and routines. Then it can be observed what are the students' behavioural responses and opinions on feedback when the teacher is present and when there is interaction with the whole class.

Conclusion

In conclusion, this study showed that students have different behavioural responses to feedback, especially about KR and delayed KCR feedback, which were provided by the games. The interviews contributed to a deeper understanding of students' experiences and teachers' perspectives on feedback provided by the tested digital English literacy games, focusing not only on types and modality, but also on levels and dimensions of feedback. The main implication for game design from this study is that, for digital educational games to be used in an educational setting, user experience involves teachers' perspectives in addition to students' experiences. Therefore, both students and teachers should be involved in designing educational games because they are the end users of this specific product and they can provide useful insights into what feedback they expect and why. Another implication is that users' needs on feedback differ among students, therefore feedback in digital English literacy games should be personalized as much as possible. Finally, it is necessary to consider the levels and dimensions behind the type and modality in which feedback will be provided. The reason is that the type and modality of feedback can support higher or lower levels of feedback for the student, thus leading to higher or lower levels of cognitive processing and, finally, enhance or impede learning.

Reference list

- Attali, Y. & Van der Kleij, F. (2017). Effects of feedback elaboration and feedback timing during computer-based practice in mathematics problem solving. *Computers & Education, 110*, 154-169.
- Benton, L., Vasalou, A., Berkling, K., Barendregt, W., & Mavrikis, M. (2018). A Critical Examination of Feedback in Early Reading Games. In *Proceedings of the 2018 CHI Conference on Human Factors in Computing Systems* (p. 373). ACM.
- De Vries, B. P., Cucchiarini, C., Bodnar, S., Strik, H., & Van Hout, R. (2015). Spoken grammar practice and feedback in an ASR-based CALL system. *Computer Assisted Language Learning, 28*(6), 550-576.
- Hargreaves, E. (2013). Inquiring into children's experiences of teacher feedback: Reconceptualising assessment for learning. *Oxford Review of Education, 39*(2), 229-246.
- Hattie, J. A., & Yates, G. C. (2014). Using feedback to promote learning. In V.A. Benassi, C. E. Overson & C.M. Hakala (Eds.), *Applying science of learning in education: infusing psychological science into the curriculum* (p. 45-58). Washington, DC: American Psychological Association.
- Hattie, J., & Timperley, H. (2007). The power of feedback. *Review of Educational Research, 77*(1), 81-112.
- Hodent, C. (2014). Chapter 10: Toward a Playful and Usable Education. In F. Blumberg (Ed.), *Learning by playing: video gaming in education* (p. 145-158). Oxford: Oxford University Press.
- Johnson, C. I., Bailey, S. K. & Van Buskirk, W. L. (2017). Chapter 7: Designing effective feedback messages in serious games and simulations: a research review. In P. Wouters & H. Van Oostendorp (Eds.), *Instructional techniques to facilitate learning and motivation of serious games* (p. 119-140). Cham: Springer International Publishing.
- Law, V., & Chen, C. H. (2016). Promoting science learning in game-based learning with question prompts and feedback. *Computers & Education, 103*, 134-143.
- Lieberman, D. A, Biely, E., Thai C. L., & Peinado, S. (2014). Chapter 13: Transfer of Learning from Video Game Play to the Classroom. In F. Blumberg (Ed.), *Learning by Playing: Video Gaming in Education* (p. 189-203). Oxford: Oxford University Press.

- Lin, L., Atkinson, R. K., Christopherson, R. M., Joseph, S. S., & Harrison, C. J. (2013). Animated agents and learning: Does the type of verbal feedback they provide matter?. *Computers & Education, 67*, 239-249.
- Mayer, R. E. (2014a). *Computer games for learning: An evidence-based approach*. Cambridge, MA: MIT Press.
- Mayer, R. E. (2014b). *The Cambridge handbook of multimedia learning (2nd ed.)*. New York: Cambridge University Press.
- Narciss, S., Sosnovsky, S., Schnaubert, L., Andrès, E., Eichelmann, A., Gogvadze, G., & Melis, E. (2014). Exploring feedback and student characteristics relevant for personalizing feedback strategies. *Computers & Education, 71*, 56-76.
- Narciss, S. & Huth, K. (2004). How to design informative tutoring feedback for multi-media learning. In H., Niegemann, R. Brünken & D. Leutner (Eds.), *Instructional design for multimedia learning* (p.181-196). Münster: Waxmann.
- Pelletier, C & Oliver, M. (2006). Activity theory and learning from digital games: implications for game design. In D., Buckingham & R., Willett (Eds.), *Digital generations: children, young people, and new media* (p. 67-92). Mahwah, NJ: Lawrence Erlbaum.
- Plass, J. L., Homer, B. D., & Kinzer, C. K. (2015). Foundations of game-based learning. *Educational Psychologist, 50*(4), 258-283.
- Prensky, M. (2001). *Digital Game-Based Learning*. New York: McGraw-Hill.
- Shute, V. J. (2008). Focus on formative feedback. *Review of educational research, 78*(1), 153-189.
- Tunstall, P., & Gipps, C. (1996). Teacher feedback to young children in formative assessment: A typology. *British educational research journal, 22*(4), 389-404.
- Van der Kleij, F. M., Feskens, R. C., & Eggen, T. J. (2015). Effects of feedback in a computer-based learning environment on students' learning outcomes: A meta-analysis. *Review of educational research, 85*(4), 475-511.
- Winne, P. H. & Butler, D. L. (1994). Student cognition in learning from teaching. In T. Husen & T. Postlewaite (Eds.), *International encyclopaedia of education (2nd ed.)* (p. 5738-5745). Oxford, England: Pergamon.

Appendix 1: Example of results from observations

Grade	Time stamp	Student	Game name	Activity	Action (mechanic)	Operation	Contradiction between		Rationale	Evidence of learning (resolution)	Community
							subject	rules			
4	0:20	1b	Reading Eggs - Spelling	Choosing the correct spelling	Chooses 1st spelling-wrong	Clicks on "louk"	subject	rules	Answers fast- Doesn't seem to know the correct answer		
						Observes feedback ("rejecting" sounds)					

	0:24				Chooses 2nd spelling-wrong	Clicks on "rish"	subject	rules	Answers fast- Doesn't seem to know the correct answer		
	0:24	1b	Reading Eggs - Spelling	Choosing the correct spelling	Chooses 2nd spelling-wrong	Observes feedback ("rejecting" sounds)					
	0:28				Chooses 3rd spelling-wrong	Clicks on "wyn"	subject	rules	Answers fast- Doesn't seem to know the correct answer		
						Observes feedback ("rejecting" sounds)					

					Waits for 2nd part to begin	Observes feedback (countdown)				no	Researcher explains that the countdown means there is a second part of the game
--	--	--	--	--	-----------------------------	-------------------------------	--	--	--	----	---

Appendix 2: Opinions about observed feedback provided and response to it (students)

Student	Quote	Code	Level of feedback	Dimension of feedback	Type	Modality	Attitude	Suggestion or observation
1a	we understood when we made the mistake	Understanding mistake		Feed-back	Outcome feedback (KR)		Neutral	O
1b	But it made me a little stressed	Understanding mistake; stress		Feed-back	Outcome feedback (KR)		Negative	O
1a	the “booo” and “yeayy”, they confused me	Game sounds confusing		Feed-back	Outcome feedback (KR)	Audio	Negative	O
1b	also because it was very fast (<i>it stressed me</i>)	Game has fast pace; confusing		Feed-back	Immediate		Negative	O
1a	I would like if there was no “booo” or “yeayy”. It was too much noise.	Game sounds confusing		Feed-back	Outcome feedback (KR)	Audio	Negative	O
1b	I liked that the little monsters were falling of the windows, it was funny.	Funny/ entertaining animations		Feed-back		Animated agents	Positive	O
2b	I understood that, when I made a mistake, my character was staying behind	Understanding mistake; character staying behind	Task-level	Feed-back	Outcome (KR)	Animated agents	Neutral	O
2b	Easy sometimes because I knew the correct answer but when I didn't know I would choose an answer randomly.	Easy when knowing the correct answer, otherwise random answers		Feed-forward			Neutral	S

3b	I noticed that there were some faces and when I was wrong I would lose one of them.	Understanding a mistake; losing "lives"	Task-level	Feed-back	Outcome (KR)	Symbols	Neutral	O
3b	My character also stayed behind in the race	Understanding a mistake; character staying behind	Task-level	Feed-back	Outcome (KR)	Animated agents	Neutral	O
3b	I didn't want more help from the game to move on.	No help from the game to move on	Self-regulation	Feed-forward			Neutral	S
3b	Yes, these small people would fall (<i>when we made a mistake</i>)	Understanding a mistake; little people falling	Task-level	Feed-back	Outcome (KR)	Animated agents	Neutral	O
4b	When we made a mistake we stayed behind	Understanding mistake; character staying behind	Task-level	Feed-back	Outcome (KR)	Animated agents	Neutral	O
4a	It stressed me a lot (<i>the timer</i>)	Stress- timer/ fast pace of game		Feed-back	Immediate	Symbols	Negative	O
4a	it was fun that they fell off the windows when we made a mistake	Understanding a mistake; funny characters falling	Task-level	Feed- back	Outcome (KR)	Animated agents	Positive	O
4a	I liked that when we made a mistake we would lose one "heart"	Understanding mistake; losing "lives"	Task-level	Feed-back	Outcome (KR) and Punishment	Symbols	Positive	O
4b	I would change the timer {in all the RE games}. It was too fast.	Too fast pace-timer-stress		Feed-back	Immediate	Symbols	Negative	O
5a	It stopped, it went slowly (<i>if wrong</i>)	Understanding mistake; character going slowly	Task-level	Feed-back	Outcome (KR)	Animated agents	Neutral	O
5b	I didn't expect help.	No help needed	Self-regulation				Neutral	S
5b	These strange animals fell off the window.	Understanding mistake; characters falling	Task- level	Feed-back	Outcome (KR)	Animated agents	Neutral	O

6a	I liked that it moved on (<i>I wrong</i>), I didn't want any help when I was playing.	Liked that the game continued when wrong; no help needed	Self-regulation	Feed-forward			Positive	O
8b	when I gave a wrong answer and they did "oooh" I became a little stressed,	Negative sounds; stress	Task-level	Feed-back	Punishment and Outcome (KR)	Sounds	Negative	O
8a	At the beginning it was difficult (<i>the game instructions</i>)	Difficult game instructions		Feed-up			Negative	O
8b	I understood the sentences because the game showed that it was for example "Dog" and then you go on	Game gives certain words and student knows what to put in the sentence	Self-regulation	Feed-forward	Elaborative (hints)		Neutral	O
9b	when we made a mistake the player didn't move	Understanding mistake; character stops moving	Task-level	Feed-back	Outcome (KR)	Animated agents	Neutral	O
9b	And when we finished, the game would show us our score.	Seeing your total score at the end of the game	Task-level	Feed-back	Delayed and Rewards (<i>scoring points</i>)		Neutral	O

Appendix 3: Opinions about feedback beyond observed incidents and responses (students)

Student	Quote	Code	Level of feedback	Dimension of feedback	Type	Modality	Attitude	Suggestion or observation
1b	I would like it if the game would circle the correct answer when I made a mistake.	Pinpoint correct and wrong answers	Task-level	Feed-back	Outcome feedback (KCR)	Symbols	Positive	S
1a and 1b	<i>(Did it help you move on after a mistake?)</i> No because it was only making sounds.	Game sounds did not help to move on		Feed-forward		Audio	Negative	O
1a	Just the “no” sound was not enough for me.	Game sounds did not help to move on		Feed-forward		Audio	Negative	O
1a	the game would “tick” the correct words and “cross” the wrong words	Pinpoint correct and wrong answers	Task-level	Feed-back	Outcome feedback (KR)	Symbols	Positive	S
1b	if the game told me how many letters the word has, by having a gap/line for each letter.	Game gives a hint/ help	Task-level	Feed-forward	Elaborative (hints)	Symbols	Positive	S
1a	Yes, but this would give us the answer directly.	Game gives a hint/help	Task-level	Feed-back	Elaborative (hints) and Outcome (KCR)	Symbols	Negative	S
2b	I usually had two correct answers in mind, so if I pressed one of them randomly and it was wrong, then	Understanding mistake; choosing among two correct answers	Self-regulation	Feed-back	Outcome (KCR)		Neutral	S

	I knew the other one is correct.							
2a	The game helped me when I made a mistake because when I gave an answer and it was wrong, then I would try to figure out the correct one.	Understanding mistake; choosing among two correct answers	Self-regulation	Feed-back	Outcome (KCR)		Positive	S
2b	I would prefer if I had some extra help when I made a mistake, to see the correct answer.	Pinpoint the correct answer	Task-level	Feed-back	Outcome (KCR)		Positive	S
2a	I liked the last one (LSP) and the previous (RE-U) because it made me think fast and helped me to learn English.	The games making think fast because of the timer	Self-regulation	Feed-back	Immediate	Symbols (timer)	Positive	O
4a	the last one was more difficult (<i>the words</i>) and it made me more stressed.	Game content too difficult-stress		Feed-up (instruction)			Negative	O
4b	(I would expect) for example the thing we threw water with would break.	Feedback expectation; something we use breaks	Task-level	Feed-back	Punishment	Animated agents/things	Neutral	S
4a	And <i>I liked</i> that we had three chances.	Chances to answer correctly	Self-regulation (<i>they try to answer correctly without help/feedback</i>)		Outcome (AUC)		Positive	O

6a	I noticed the clapping stopped	Understanding mistake; clapping stops	Task-level	Feed-back	Outcome (KR)	Audio	Neutral	O
6a	the orange line would not appear when we made a mistake.	Understanding mistake; orange line stops appearing	Task-level	Feed-back	Outcome (KR)	Symbols	Neutral	O
8a	I got confused (<i>when characters fell off the window</i>)	Characters falling-confusing	Task-level	Feed-back	Outcome (KR)	Animated agents	Negative	O
8a	Yes, I would like that (<i>to see the correct answer</i>)	Expecting to see the correct answer	Task-level	Feed-back	Outcome (KCR)		Positive	S

Appendix 4: Opinions about observed feedback provided and response to it (teachers)

Teacher	Quote	Code	Level of feedback	Dimension of feedback	Type	Modality	Attitude	Suggestion or observation
1	In my opinion, such sounds (<i>negative or praising</i>) make the game livelier.	Sounds make the game livelier		Feed-back	Rewards or Punishment	Audio	Positive	O
1	As long as the sounds are chosen in a way that doesn't bring down children's confidence	Sounds of the game should not harm children's confidence	Self-level	Feed-back	Punishment	Audio	Neutral	S
1	The praising sounds are louder than the "rejecting" sounds.	Praising sounds louder than "rejecting" sounds		Feed-back	Rewards and Punishment	Audio	Neutral	O
1	in the classroom it is a chance to involve other students, like "who can help us here and tell us the correct answer?"	Involving the whole class for correct answer	Task-level	Feed-back	Outcome (KCR)		Positive	S

1	I think it is necessary that they get feedback in the end with the total of correct answers, like an overview.	Need for feedback with correct answers in the end of game	Task-level	Feed-back	Outcome (KCR) and Delayed		Positive	O
1	I believe this (<i>character staying behind</i>) can actually bring her confidence down.	Character staying behind can harm confidence	Self-level	Feed-back	Punishment	Animated agents	Negative	O
1	I noticed that (<i>what happened when they gave the correct or wrong answer</i>) because it also caught my attention with all the colours, the movement and the interaction.	Noticed feedback on wrong answer because of colours and movement	Task-level	Feed-back	Outcome (KR)	Animated agents	Neutral	O
1	<u>R</u> : There is also someone reading the whole sentence. <u>T</u> : Yes, this is	Students should see and hear the correct answer	Task-level	Feed-back	Outcome (KCR)	Text and audio	Positive	O

	important, that they see and hear the correct sentence as a whole.							
2	Even if you understand the instructions the first time and choose the odd word, you get carried away during the rest of the game and start choosing the rhyming words.	“Choose the odd word game” (instructions) can confuse students	Process-level	Feed-up			Negative	O
2	Because with these tables it (the correct answer) won't “stick” to your mind.	Delayed feedback-tables with correct answers in the end not useful	Task-level	Feed-back	Outcome (KCR)	Text	Negative	O
2	<i>(Drawbacks of feedback in RE.)</i> It is given in the end and with no chance to explain to the student why it was	Feedback in the end and not elaborative; drawback		Feed-back	Delayed and Outcome (KCR)		Negative	O

	wrong							
2	(words green and sentence read aloud in LSP): in this way it will “stick” better to their mind	Highlighting and reading aloud correct answer-> stays in student’s mind	Task-level	Feed-back	Outcome (KCR)	Highlighting and audio	Positive	O
2	(LSP) the children will still understand their mistake because of these animated character that the game uses.	Animated agents can help understand your mistake	Task-level	Feed-back	Outcome (KR)	Animated agents	Neutral	O
2	In the RE it (the timer) was quite fast which could stress students.	Fast timer can stress		Feed-back	Immediate	Symbols	Negative	O
2	it can cause problems and make even good students answer fast and randomly	Fast timer can make students answer fast and randomly		Feed-back	Immediate	Symbols	Negative	O

Appendix 5: Opinions about feedback beyond observed incidents and responses (teachers)

Teacher	Quote	Code	Level of feedback	Dimension of feedback	Type	Modality	Attitude	Suggestion or observation
1	I don't think it really matters <i>if the correct answers are not shown during the race.</i>	Not showing the correct answers after each item	Task-level	Feed-back	Immediate and Outcome (KCR)		Neutral	O
1	You, as a teacher, can give them a hint to find the correct answer.	Teacher gives hint to correct answer		Feed-back	Elaborative (hints)		Positive	S
1	<i>(about hints)</i> It is better than giving the students the correct answer ready.	Hints better than giving the correct answer		Feed-back	Elaborative (hints) and Outcome (KCR)		Positive	S

1	I don't think this is very important <i>that some tables have "correct-incorrect" and others "your answer-correct"</i> .	Names of categories in final table are not important		Feed-back	Outcome (KCR)	Text	Neutral	O
1	What is important is that they can understand and remember what the correct answers are	To remember and understand the correct answers	Task-level	Feed-back	Outcome (KCR)		Positive	S

1	<i>(No correct answer when they are wrong)</i> but when they are falling it catches their attention and the children think of which answer was correct. They make the association.	Characters falling when you are wrong but not giving correct answer makes them think	Self-regulation	Feed-back (characters falling) and Feed-forward (self-regulation)	Outcome (KR)	Animated agents	Positive	O
1	This is one type of feedback, and sometimes it is also better that they think about the correct answers themselves.	Students should think of the correct answer themselves	Self-regulation	Feed-forward	Outcome (KCR)		Positive	S
1	It is better when they just get a hint, otherwise the answers are always ready for them	It is better to give students hints		Feed-back	Elaborative (hints)		Positive	S

2	I repeat what they say with a question mark, I don't give them clear directions.	Repeating student's response as a question	Task-level	Feed-back	Outcome (KR)		Neutral	S
2	You can also make facial expressions when they are wrong so that they understand they are wrong.	Facial expressions to help student understand his answer is wrong	Task-level	Feed-back	Outcome (KR)		Neutral	S
2	But instruction is very important because you need to test or practice a certain skill each time.	Importance of instruction in order to practice a skill		Feed-up			Positive	S
2	I think this (table in end of RE games) only has a point if children keep like a diary with their correct and incorrect answers.	Delayed feedback with answers can be used for students to keep track of their progress		Feed-back	Delayed	Text	Neutral	S

2	better to have the answers during gameplay, because then it is more likely that students will remember the correct answers	Better to show the correct answers during gameplay	Task-level	Feed-back	Outcome (KCR)		Positive	S
2	In the classroom, if many children do the same mistake, we spend some time to explain the sentence and give an example.	Providing explanation and examples about common mistakes	Task-level	Feed-back	Elaborative (response-specific and worked examples)		Neutral	S
2	(words green and sentence read aloud in LSP): It also feels like getting a reward.	Correct answer feedback in LSP is like a reward too		Feed-back	Rewards		Neutral	O
2	I like the feedback with these animated characters, while the correct answer is also there in text and it is read by	Feedback should include animated agents, showing the correct answer in text and read (LSP)	Task-level	Feed-back	Outcome (KCR)	Animated agents, text and audio	Positive	S

	someone							
2	Maybe the game can count how many mistakes you have and after a certain number it can stop you and provide you some kind of explanation or an example.	Game could provide examples and explanations after a specific number of player's mistakes		Feed-back	Elaborative <i>(all)</i>		Neutral	S
2	It is the teacher's job to intervene and provide explanations and examples.	Explanations and examples should be provided by the teacher		Feed-back	Elaborative		Positive	S