CRITICAL REVIEW PAPER 1

Tiffany Hightower

EDU 800

Central Michigan University

10-23-16

Problem (about 1 page)

1. Identify the clarity with which this article states a specific problem to be explored.

This article provided various indications of the specific problems to be explored in this research. The abstract states that, “Although many studies have investigated the effects of digital game-based learning (DGBL) on learning and motivation, its benefits have never been systematically demonstrated.” (Erhel & Jamet, 2013, p. 156). This statement revealed that Erhel and Jamet (2013) believed that the problem with prior DGBL research is that there has not been enough systematic research regarding the benefits of DGBL. Therefore, they conducted two systematic experiments to determine the effectiveness of DGBL when it is used with learning instruction versus entertainment instruction. The first experiment was an analysis of how learning instruction and entertainment instruction impacted achievement and motivation in digital game based learning. Then, the second experiment sought to determine if adding consistent feedback to entertainment instruction would enhance cognition and learning.

The specific problem to be explored in Experiment 1 is as follows:

> The aim of this study was thus to ascertain whether the effects of instructions given during the reading phase that have been observed for text-based learning would also manifest themselves during DGBL. We administered a digital learning game in either a learning condition, where participants were asked to learn with ASTRA, or an entertainment condition, where they were asked to play with ASTRA. (Erhel & Jamet, 2013, p. 158).

The specific problem that was explored in Experiment 2 is as follows, “In this second experiment, we set out to determine whether the presence of KCR feedback in DGBL quizzes can influence the types of learning strategies induced by the instructions (i.e., entertainment or learning).” (Erhel & Jamet, 2013, p. 162).

Erhel and Jamet (2013) provided an overview of the problem in the abstract. They also specified the problems that were going to be explored in Experiment 1 and Experiment 2. In addition, they explained the type of learning conditions that were used to compare and contrast the results of Experiment 1. They also specified that the variable of Knowledge of Correct Response (KCR) feedback would be added to Experiment 2 to determine if achievement was impacted. Therefore, the research problems were provided with clarity, since they specified the problems and learning conditions to be explored in this research.

2. Comment on the need for this study and its educational significance as it relates to this problem.

This study is needed in the field of educational technology since educators must validate the instructional effectiveness of technology mediums and tools when using them with learners. The study compares the effectiveness of learning instruction to entertainment instruction in DGBL. It is important to know which type of instruction results in deeper learning to select the best instructional technology approach to maximize the education of students. This study revealed that deeper learning occurs with learning instruction more than entertainment instruction. However, the second experiment revealed that incorporating feedback into entertainment instruction showed an increase in student achievement and substantial motivation among students. This is relevant information because educators will be aware that learning

instruction resulted in deeper cognition, and that deeper learning does not occur when entertainment instruction is provided in isolation. However, entertainment instruction requires regular feedback to be incorporated with it to facilitate deep learning. This will assist with implementing the best pedagogical features of DGBL.

3. Comment on whether the problem is "researchable"? That is, can it be investigated through the collection and analysis of data?

The problem of measuring the motivation and knowledge acquisition of learners in entertainment instruction and learning instruction in DGBL is researchable because of the methodological approaches that are implemented in this study. Erhel and Jamet (2013) provided learners with different versions of the *same* game, which helped to improve the validity of the results. Utilizing the same game in all aspects of the experiment provided a constant, and the variables of the type of instructions and feedback were measured separately in each experiment to further validate the results. The surveys and questionnaires that were administered were reliable tools to measure the knowledge acquisition, ability to make inferences, and motivation among the experiments' participants, which provided qualitative data that could be analyzed to draw conclusions and determine the results of the experiments.

Erhel and Jamet (2013) reflected on previous approaches used to analyze DGBL's effectiveness and discovered a need to be more systematic in the approach they used. Their decision to use the same game, but different variables allowed them to be able to research, collect data and analyze data for the experiments in a methodological process, which they elaborate on in the following quote:

> Many authors have adopted a media comparison approach, measuring the learning outcomes of people who play an educational game against the learning outcomes of people who learn through conventional media. This methodology is vulnerable to many confounding factors (e.g., format, pace, educational content, teacher's social presence), which prevent us from clearly identifying the factors responsible for the benefits of DGBL. To avoid these methodological limitations, we favored another approach in our two experiments, namely the value-added approach (see Adams, Mayer, MacNamara, Koenig, & Wainess, 2012, for a recent example of this approach), which involves comparing the learning outcomes of learners receiving different versions of the same educational game. (Erhel & Jamet, 2013, p. 157).

Therefore, the approach of comparing outcomes of the same game was done in a systematic way to ensure valid and reliable data collection and analysis. This approach alleviated the inconsistent variables that can occur when comparing DGBL with conventional teaching methods.

Theoretical Perspective and Literature Review (about 3 pages)

4. Critique the author's conceptual framework.

Erhel and Jamet (2013) reflected on previous research that has been conducted regarding instruction and feedback used in traditional texts and DGBL to develop a conceptual framework for this study. Analyzing the pros and cons of previous research assisted them in developing a systematic approach for their conceptual framework, which was implementing a value-added approach of using the same game for both experiments.

Erhel and Jamet (2013) used the conceptual framework of using the same ASTRA game to determine if different learning results and motivation would occur from providing learning instructions, entertainment instructions and feedback to learners using ASTRA DGBL. They divided these variables into two experiments to ensure that the variables were measured separately for validity. I believe this conceptual framework resulted in reliable data collection and analysis that can assist with improving the body of knowledge regarding DGBL.

5. How effectively does the author tie the study to relevant theory and prior research? Are all cited references relevant to the problem under investigation?

The research and theory used as a literature review for this study indicated various fluctuations in the theories surrounding DGBL. I believe that it would have been more beneficial to conduct additional research that could have provided more consistent data regarding the effectiveness of learning instruction, entertainment instruction, feedback and engagement in DGBL. In addition, the prior research discussed the effects of comparing DGBL to traditional texts and conventional classroom instruction, which was not the focus of this study. Therefore, more relevant theory and prior research specifically pertaining to studies using the ASTRA game, or other studies that conduct research specifically using DGBL can provide an enhanced theoretical framework for analysis of the results of this study.

The following excerpt from Erhel's and Jamet's (2013) study revealed the inconsistent data attained from prior research and theory:

> Although results indicate that digital learning games are of debatable educational worth, the vast majority of researchers now acknowledge their benefits in terms of motivation

> and engagement. In a literature review of 68 studies, Randel et al. (1992) noted that just 22 studies comparing digital games with conventional classroom instruction concluded that games/simulations had a beneficial effect on learning performance. Nonetheless, the authors found that 12 of the 14 studies looking at motivation concluded that DGBL is more beneficial than traditional classroom learning. These findings, subsequently corroborated by a review of the literature undertaken by Hays (2005), were extended by Vogel et al. (2006), who demonstrated the learning benefits of digital games. In a meta-analysis of 32 studies, these authors found that educational games and interactive simulations had a positive effect on learning quality, compared with more traditional forms of teaching. Furthermore, learners displayed more positive attitudes toward learning methods based on educational games/simulations, than toward more conventional ones. More recently, however, an analysis by Kebritchi et al. (2013) has raised fresh doubts about the benefits of DGBL. (Erhel & Jamet, 2013, p. 158).

This quote explained that DGBL research has inconsistent findings, which results in uncertainty regarding the reliability of the literature review.

6. Does the literature review conclude with a brief summary of the literature and its implications for the problem investigated?

Erhel and Jamet (2013) provided a summary of their literature review regarding the depth of learning acquisition that can occur in different DGBL settings. They emphasized the pertinence of the learner's goals, interests and motivations impacting the way they perform in learning activities, especially DGBL with entertainment instructions. The following summary in

the review of literature provided the theoretical framework for Erhel and Jamet's (2013) hypotheses and implications for the problems investigated in Experiment 1 and Experiment 2:

> Whichever interpretive framework we choose to apply, the message is that learners who do not actively invest in information processing are liable to engage in merely surface learning and achieve only modest learning performances. This is an all too likely scenario in an incidental learning context involving DGBL, where the instructions given to learners encourage them to play rather than to learn. In other words, when the emphasis is placed on the playful components of a digital learning game, learners may fail to put in the effort required for learning. (p. 158)

Erhel and Jamet (2013) added additional components to their review of literature for Experiment 2. The following summary discussed that various types of feedback provided different results in DGBL learning acquisition. This additional literature review summary focused more on the specific variable of incorporating feedback in Experiment 2. According to Erhel and Jamet (2013),

> These activities can be triggered by the presence of features such as feedback (Moreno & Valdez, 2005). Feedback in educational games appears to reduce redundant cognitive processes, all the while supplying learners with schemas to help them correct their comprehension errors (Clark & Mayer, 2008). This was demonstrated by Leutner (1993), in a study using a digital game designed to teach environmental principles. He found that a version incorporating explanatory feedback significantly improved recall performances compared with a version where no feedback was available. Although Leutner chose to

> provide explanatory feedback in his study, there are many other types of feedback, depending on their length, specificity, timing and complexity (Shute, 2008). (p. 162)

These summaries discussed the limitations, implications and conclusions that can be drawn from this study's methodological approach.

7. Evaluate the clarity and appropriateness of the research questions or hypotheses.

Erhel and Jamet (2013) decided to use a value-added approach for this study, which means they compared feedback and instructions that were added to the same game. However, the following hypotheses that they generated discussed comparisons to traditional text-based learning, which did not clarify and specify the value-added approach specifically for DGBL used in this study.

> The aim of this study was thus to ascertain whether the effects of instructions given during the reading phase that have been observed for text-based learning would also manifest themselves during DGBL. We administered a digital learning game in either a learning condition, where participants were asked to learn with ASTRA, or an entertainment condition, where they were asked to play with ASTRA. (Erhel & Jamet, 2013, p. 158).

Erhel and Jamet (2013) listed numerous additional hypotheses in this study. Some of them do not have as much clarity to assist with a clearer understanding of the study, but the hypotheses are appropriate for the study being conducted. Additional hypotheses are as follows:

> Concerning learning and intrinsic motivation, this study was designed to test two contrasting assumptions. First, if the nature of the instructions influences learners'

> motivational investment, then an entertainment instruction would improve our participants' subjective experience (e.g., Vogel et al., 2006), reflected in significantly higher intrinsic motivation scores. Furthermore, in accordance with previous research on the positive effects of motivation on learning in DGBL (Lieberman, 2006), the participants in the entertainment instruction condition would achieve a higher learning outcome.
>
> By contrast, if the nature of instruction affects the relevance of the processes that are implemented during an activity, then compared with the entertainment instruction, the learning instruction would result in significantly higher scores on the different learning assessments, especially on inference-type questions assessing the quality of deep learning. Furthermore, the entertainment instruction would hinder the learners' subjective experience, reflected in significantly lower intrinsic motivation scores. (Erhel & Jamet, 2013, p. 158).

Presenting the hypotheses in paragraph formatting decreased the clarity of the hypotheses because it was more difficult to compartmentalize the hypotheses developed for the separate experiments. Perhaps incorporating a labeled table or graphic that specifically listed the hypotheses for Experiment 1 and Experiment 2, as well as hypotheses regarding the variables of entertainment instruction, learning instruction and feedback could have added more clarity to the way the hypotheses and research questions were conveyed in this study.

Research Design and Analysis (about 3 pages)

8. Critique the appropriateness and adequacy of the study's design in relation to the research questions or hypotheses.

Erhel and Jamet (2013) synthesized the methodologies used in prior research and developed a better approach to DGBL research. According to Erhel and Jamet (2013), "To avoid these methodological limitations, we favored another approach in our two experiments, namely the value-added approach (see Adams, Mayer, MacNamara, Koenig, & Wainess, 2012, for a recent example of this approach), which involves comparing the learning outcomes of learners receiving different versions of the same educational game. (p. 157).

Therefore, this study was designed using one ASTRA digital game as the constant in all aspects of the experiment, which increased the validity of this study. Erhel and Jamet (2013) also decided to divide the study into two experiments to ensure the specific variables were studied separately and validly. Experiment 1 focused on comparing and contrasting the variables of entertainment instruction versus learning instruction in ASTRA. According to Erhel and Jamet (2013), "We administered a digital learning game in either a learning condition, where participants were asked to learn with ASTRA, or an entertainment condition, where they were asked to play with ASTRA. (p. 158) These variables were studied to determine whether the level of learning acquisition, cognition and motivation of learners would differ significantly based on the condition. They defend their reasoning for this approach in the following excerpt:

> For the present experiment, we therefore adopted what we believe is a more rigorous approach, namely the value-added perspective (Adams et al., 2012). This meant that the only variation would be in the nature of the instructions given for a digital learning game called ASTRA (Appréhender par la Simulation les TRoubles liés à l'Age). (Erhel & Jamet, 2013, p. 158).

Erhel and Jamet (2013) wanted to determine how motivation was impacted in the different DGBL learning conditions of ASTRA. They explained the design methodology regarding motivation as follows, “Concerning learning and intrinsic motivation, this study was designed to test two contrasting assumptions. First, if the nature of the instructions influences learners’ motivational investment, then an entertainment instruction would improve our participants’ subjective experience (e.g., Vogel et al., 2006), reflected in significantly higher intrinsic motivation scores. (Erhel & Jamet, 2013, p. 158). This is an appropriate and adequate design because motivation can be analyzed based on the data collected from questionnaires of learners.

This study was also designed to research achievement and learning acquisition of learners using ASTRA. According to Erhel and Jamet,

> Concerning achievement goals, we predicted that the learning instruction would prompt the learners to pursue mastery goals by developing their skills, while the entertainment instruction would encourage them to flaunt their ability to successfully perform the game in order to achieve performance-approach goals. Similarly, we predicted that the entertainment instruction would encourage them to pursue the perfomance–avoidance goals by promoting their fear of failing and performing more badly than the others (Elliot & McGregor, 2001). (Erhel & Jamet, 2013, p. 158).

Therefore, the methodology and design of this study included experiments that measured how different variables would impact various aspects of learning including motivation and achievement. This study researched the multifaceted and interrelated aspects of DGBL and has a design method to explore them through scientific inquiry.

This study had a different design method, which explored feedback that was incorporated into the ASTRA game in Experiment 2. The research questions and design method were elaborated on in the following excerpt:

> In this second experiment, we set out to determine whether the presence of KCR feedback in DGBL quizzes can influence the types of learning strategies induced by the instructions (i.e., entertainment or learning). In line with Clark and Mayer (2008), we predicted that the addition of feedback containing the correct response would reduce redundant, superficial cognitive processing, thereby making learning more relevant in both the entertainment and learning instruction conditions. As in Experiment 1, the digital learning game was administered to learners in two conditions: a learning condition, where participants were invited to learn with ASTRA, and an entertainment condition, where they were invited to play with ASTRA. (Erhel & Jamet, 2013, p. 162).

This excerpt explained the value-added design and how that will impact the research questions in a valid way. They also designed the feedback to facilitate higher level cognition and inferencing of learners, which are also adequate aspects of the design methodology.

9. Critique the adequacy of the study's sampling methods (e.g., choice of participants) and their implications for generalizability.

The sampling methods were adequate for this study because there were enough participants of both genders. In addition, participants were tested prior to the study to determine their prior knowledge regarding the diseases presented in the ASTRA digital learning game, and did not include medical students with extensive prior knowledge of the ASTRA content. Participants with too much prior knowledge were eliminated from the study to ensure the validity

of achievement scores in ASTRA. Although this sample was sufficient for this smaller study, this sample of participants cannot be applied to generalizability, since the participants did not represent or reflect the learning population as a whole, and the sample group is not large enough. The age range of the participants excluded preschool students, K-12 education, graduate students and adult learners. In addition, the sample did not reflect various demographics throughout the country or the world. Therefore, generalizability cannot be attained in this particular study. The following excerpt presents the dynamics of the participants in Experiment 1.

> Participants Experiment 1
>
> A total of 46 participants (22 men and 24 women) aged 18–26 years (M ¼ 20.67, SD ¼ 1.92) took part in this study. They were recruited from a pool of students from several universities in Rennes. Students enrolled in medical or allied health programs were excluded. They were all undergraduates and had been at university for 2.27 years on average (SD ¼ 1.30).
>
> The learning instruction group was made up of nine men and 15 women, who had a mean age of 20.75 years and were mainly in their third year of university. The entertainment instruction group was made up of nine men and 15 women with a mean age of 20.75 years. (Erhel & Jamet, 2013, p. 159).

The participants of Experiment 2 also had a similar sampling of students that reflected similar adequacy and generalizability factors as the participants in Experiment 1.

10. Critique the adequacy of the study's procedures and materials (e.g., interventions, interview protocols, data collection procedures).

The following materials and procedure were used in both experiments of the study according to Erhel and Jamet (2013):

> The participants interacted with the ASTRA multimedia learning environment for approximately 25–30 min. This environment takes the form of a simulated living room where a female pedagogical agent stands next to a TV screen. The agent's role is to provide the participants with oral information, giving them instructions at the start of the simulation, commenting on the sequences displayed on the TV screen, probing the learners' reactions to certain symptoms, and testing the learners in quizzes. The ASTRA simulation introduces learners to four aging-associated diseases: Alzheimer's disease, Parkinson's disease, myocardial infarction and stroke. Each presentation comes in five parts: (1) an introduction featuring an instruction; (2) a multimedia presentation in which a character displays a set of symptoms (see Fig.1); (3) a transitional question asking learners about the right way to react to these symptoms; (4) a sequence describing the disease in detail; and (5) a quiz with four questions assessing the participants' recall. In the quizzes, participants were given to understand that their answers could earn them points, but they were not given any immediate information as to whether they had answered correctly. (Erhel & Jamet, 2013, p. 159).

Therefore, the ASTRA digital game provided the materials and had a built in sequence of procedures that learners engaged in during this study. Erhel and Jamet (2013) adjusted portions of the procedures in ASTRA to fit the variables of Experiment 1 and Experiment 2. In Experiment 1, they added learning instruction for one sample group, which they predicted would result in deeper concentration and learning, and added entertainment instruction for another sample group, which they predicted would result in surface or lower level learning, since learners

may exhibit a more playful attitude towards the entertainment instructions. They also hypothesized that motivation and engagement would be high for both sets of instructions since the content was formatted in a digital game environment. These procedures were adequate, since they correlated with the research questions and hypotheses developed in this study.

This study used the exact same quiz questions for the different learning conditions in Experiment 1. This was an adequate and valid way to collect and analyze achievement data since it applies the value-added approach, which decreases limitations and increases the validity of the results. The participants were also provided questionnaires at the end of Experiment 1 that gathered data on learning goals and motivation that correlate to the research questions. Erhel and Jamet (2013) described the questionnaire containing fifteen questions as follows:

> Twelve learning goal items (3 mastery goal approach items, 3 mastery goal avoidance items, 3 performance goal approach items, 3 performance goal avoidance items) assessed the reasons why the participants engaged in learning, while three intrinsic motivation items measured the extent of their desire to engage in the task for its own sake. Participants had to express their level of agreement with each item on 7-point Likert-like scales (Table 1). (Erhel & Jamet, 2013, p. 160).

The questionnaire adequately gauged students' motivation levels and goal setting styles for learning acquisition and added additional questions regarding their ability to make inferences regarding the content. The questions were varied and multiple aspects of each goal criteria were surveyed to increase the validity of the data collection.

Experiment 2 presented the exact same format of the ASTRA game. However, the following independent variables were adjusted:

> This new experiment, however, was characterized by the addition of KCR (knowledge of correct response) feedback for each of the questions in the four disease quizzes. Each time a participant responded correctly, a window opened with the message "Right answer". Each time a participant responded incorrectly, a window opened with the message "Wrong answer", plus the correct response (Fig. 3). As in Experiment 1, we manipulated the Instruction independent variable. (Erhel & Jamet, 2013, p. 162).

The methodology used in Experiment 2 adequately added procedures that would result in valid data regarding the research questions of whether adding KCR feedback would improve achievement and motivation. The results demonstrated that entertainment instruction improved the depth of learning with feedback, which was valuable knowledge regarding ways to enhance DGBL.

11. Critique the appropriateness and quality (e.g., reliability, validity) of the measures used.

Erhel and Jamet (2013) excluded medical students from this study and conducted analysis of prior knowledge of participants to ensure that achievement scores were a result of the learning from ASTRA and not invalidated by prior knowledge. They had a large enough sample size from both genders to conduct this study, although the sample size cannot be used for generalizability of the population as a whole. They used the value-added approach to prevent limitations of the data collected. The value-added approach allowed them to focus on one constant throughout both experiments, which was the ASTRA digital learning game. This also enhanced the validity because of the consistent medium, procedures and questions embedded in the ASTRA game. The ASTRA quizzes were the same for the entertainment instruction and learning game instruction participants in both experiments, which assisted with the validity of the results. The

questionnaires provided after the games asked questions related to the research questions and hypotheses to provide specific data regarding achievement, motivation, inferencing abilities of learners using ASTRA. All of the measures used to conduct this study were appropriate because the measures were specifically designed to answer research questions and confirm or deny the hypotheses.

12. Critique the adequacy of the study's data analyses. For example: Have important statistical assumptions been met? Are the analyses appropriate for the study's design? Are the analyses appropriate for the data collected?

According to the general discussion, Erhel and Jamet (2013) had the following results. "We observed better comprehension performances with the learning instruction condition in Experiment 1, and with the combination of entertainment instruction and KCR feedback in Experiment 2. By contrast, neither experiment revealed any effect of instruction on responses to the paraphrase-type questions, even though deep learning results in better memory storage." (p. 164). This analysis is related to the research question and the way the study was designed.

A closer examination of the quantitative data of Experiment 2 provided more information regarding how data was analyzed. The research question for Experiment 2 was to determine if adding feedback would produce a difference in learning achievement of ASTRA with entertainment instructions versus learning instructions. According the following data analysis, "The difference between the learning instruction (M ¼ 12.87, SD ¼ 2.16) and entertainment instruction groups (M ¼ 13.00, SD ¼ 1.87) on recall scores was not significant ($F < 1$)." (Erhel & Jamet, 2013, p. 162). Therefore, the recall scores addressed part of this question. The research also revealed higher achievement on the making inferences questions when feedback was

incorporated into the digital game. So, this data analysis related to the study's design and the data collected. Another part of the data analysis revealed, "In other words, the learning instruction appeared to have generated a greater fear of failure than the entertainment instruction did." (Erhel & Jamet, 2013, p. 163). This data analysis did not specifically correlate to the components of achievement and motivation. I assume that fear of failure can somewhat correlate to motivation, which may derive from the extrinsic motivator of feedback.

C. Interpretation and Implications of Results (about 3 pages)

13. Critique the author's discussion of the methodological and/or conceptual limitations of the results.

According to Erhel and Jamet (2013), "Our study shows that this form of feedback can prove extremely relevant to DGBL, in relation to type of instruction. Even so, given the current state of knowledge, we cannot say whether these positive effects could be generalized to all types of feedback, especially simpler kinds (i.e., corrective)." (p. 165) This explained that researchers must not assume that providing feedback will have the same results in all domains and types of DGBL. Erhel and Jamet (2013) also discussed limitations of minimal interactivity in ASTRA, and participants did not have an abundance of feedback on quizzes, since they had high achievement. These factors presented limitations regarding the generalizability of this study.

These limitations also related to the findings in the literature review. Since there was no consensus regarding motivation and achievement using DGBL in the literature review, most of the prior studies must have also exhibited similar limitations that impacts consistency of DGBL

data. Therefore, we must synthesize the data and recognize that limitations prevent precise educational technologies theories that can apply to all domains.

14. How consistent and comprehensive are the author's conclusions with the reported results?

Erhel and Jamet (2013) did not discover much difference in the recall quiz scores of Experiment 1 on page 161. However, they expressed contradictory information regarding comprehension in the following excerpt. "We observed better comprehension performances with the learning instruction condition in Experiment 1, and with the combination of entertainment instruction and KCR feedback in Experiment 2." (Erhel & Jamet, 2013, p. 164). If the recall quiz scores, which provided comprehension data, were not significantly different in Experiment 1, then later stating that learning instructions provided better comprehension is inconsistent. They also made the following statement that contradicts the recall quiz scores' data as well. "In line with our expectations, the first experiment allowed us to demonstrate that participants who were given an entertainment instruction performed significantly more poorly on comprehension than those given the learning instruction." (Erhel & Jamet, 2013, p. 164).

The authors' conclusions seemed inconsistent in some instances. However, the overall conclusions answered the research questions and confirmed or denied their hypotheses.

15. How well did the author relate the results to the study's theoretical base?

The authors provided the following information that showed correlations of their study to other theoretical perspectives included in the literature review.

> Although the paraphrase results ran counter to our hypotheses, this was not the case for the inference-type questions. In line with our expectations, the first experiment allowed us to demonstrate that participants who were given an entertainment instruction performed significantly more poorly on comprehension than those given the learning instruction. These results supported the findings of van den Broek et al. (2001), by showing that entertainment instructions induce less efficient information processing strategies than learning instructions do. They also corroborated the observations of Beentjes et al. (1993), as well as those of van Asselen et al. (2006), by demonstrating that shallow cognitive processes may prevail in situations where learners are not explicitly encouraged to learn. (Erhel & Jamet, 2013, p. 164).

Acknowledging the findings of other researchers and comparing their findings to this study is an attempt to express consistency in this sort of Digital Game Based Learning experiment. They also tied Experiment 2 to prior research in the following quote. “Our results extend Leutner (1993)’s findings that adding feedback in DGBL enhances memorization.” (Erhel & Jamet, 2013, p. 164). Providing examples of the connections of the results of this study to prior research assisted with enhancing the validity and reliability of this research.

16. In your view, what is the significance of the study, and what are its primary implications for theory, future research, and practice?

This study is significant because it can lay a foundation for best practices that can be used for DGBL. Educators that use DGBL want research that confirms that the technology is effective and will yield high level cognition and achievement for learners. Components of learning instructions versus entertainment instructions and applying feedback to answers can be features

that have a large impact on how learners respond, participate and stay motivated throughout the game. The implications are that utilizing learning instructions and feedback in future DGBL development can possibly improve the content of DGBLs, and enhance the achievement of students. The results of this study, prior research and future research can be synthesized to develop systematic DGBL best practices that can be implemented to enhance DGBL.

Erhel and Jamet (2013) also provided suggestions for future studies as follows, “The latter presented the environment as either a learning module or a game, but did not explicitly encourage the participants to memorize the information. Future studies are needed to test this hypothesis.” (p.164) They also suggested that, “In order to observe greater benefit from feedback, we would need to replicate Experiment 2 with more taxing quizzes.” (p.165) These suggestions for future studies can assist in creating more reliability and validity in DGBL research and further expand the knowledge base of educational technology research.

Bibliography

Erhel, S. & Jamet, E. (2013) *Digital game-based learning: Impact of instructions and feedback on motivation and learning effectiveness.* Computers & Education. pp. 156-157.