EXPLORING AFFORDANCES FOR MULTILINGUAL LEARNERS IN A GAME-BASED LEARNING ENVIRONMENT

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Abstract

As part of ongoing iterative project design and development, we interviewed students regarding their experiences in the digital game-based learning environment (GBLE) MISSIONS WITH MONTY to inform game enhancements and leverage multilingual learners' (MLs) language assets. The evidence in support of well-designed educational games is mounting, yet few projects have focused primarily on customizing environments for MLs. Fifth-grade students (*n* = 28) participated in this first round of structured interviews after playing MISSIONS WITH MONTY. Findings indicated that students reported learning from the game, with most preferring reading and learning science in the game over traditional instruction. Primary themes indicated *game elements and design features* and *learning in the game* captured their favorite, least favorite, and most challenging perceptions regarding the game. MLs were split in their desire for a translated game with several suggesting it might help other learners despite not having interest themselves; and others suggesting it would benefit their learning in their nonprimary school language. Results from the study will inform the next round of student interviews and future game enhancements.

Keywords: Game-based learning; Multilingualism; Science; Reading.

1 INTRODUCTION

Learning to comprehend informational science texts is challenging for upper primary students and becomes even more complex for students learning to comprehend such texts in a second language. These multilingual students (MLs) bring forth a set of abilities unique from monolinguals, however they are also faced with learning technical academic language in a language they are simultaneously learning to master. Digital game-based learning environments (GBLEs) offer the possibility to adapt to learner needs in real time and could potentially customize learning for MLs. Yet, these possibilities remain theoretical and presently undeveloped. The goal of our current research is to develop practical approaches to close the learning gap between MLs and non-MLs in science literacy within the context of a GBLE entitled MISSIONS WITH MONTY. The present study will present efforts from the first stage of this design-based approach to customizing the GBLE for MLs wherein student interview data were gathered.

GBLEs are increasingly associated with learning gains [1, 2], having a positive impact across curricular areas such as reading [3], language learning [4], and STEM [5]. Educators also increasingly recognize the benefits of GBLEs to enhance student motivation, engagement, and learning [6]. GBLEs provide unique contexts and opportunities for individualized student learning through practice and feedback. Further, digital games hold promises to support students' self-regulated learning (SRL). Self-regulated learning involves the monitoring and regulation of learning goals and incorporates metacognition, strategic processing, and motivational variables. Self-regulated learners are goal directed, aware of their own learning, and have knowledge of strategy implementation [7,8]. Not only can GBLEs support SRL as an outcome but previous research has established that SRL is predictive of science learning in GBLEs [9].

The current project takes a unique approach to addressing science literacy with a GBLE developed within an SRL framework, called MISSIONS WITH MONTY. Findings thus far have shown significant increases in reading comprehension, science learning, and metacognitive calibration for 5th grade students after approximately six weeks of interaction [10,11]. Our aim is to adapt MISSIONS WITH MONTY to provide fully customized scaffolds for Spanish-speaking MLs. MLs are vastly underrepresented in STEM fields [14] and have little representation as scientists [13]. The GBLE would provide a familiar and consequence-free environment for students to engage with science, offer opportunities to freely use bilingual skills to support learning, obtain immediate feedback, and engage in distributed practice cycles to encourage learning over time. For MLs, metalinguistic knowledge, and metacognitive knowledge and skills are intertwined with vocabulary knowledge in the developmental process of

learning a second language [14]. MISSIONS WITH MONTY currently provides training and distributed practice to build metacognitive knowledge and skills. The current project focuses on providing support for metalinguistic knowledge by providing the ability to freely toggle languages, and vocabulary knowledge will be scaffolded throughout the game with in-text scaffolds (e.g, definitions, pronunciation, images).

Teachers incorporate MISSIONS WITH MONTY (see Fig. 1) as part of typical classroom-based instruction. Gameplay is situated within a goal-directed narrative. Players fill the role of a promising young science professor traveling to work with Monty, a monitor lizard and world-renowned scientist known for his ability to solve real-life problems. Monty has created Wildlife University (WU) in a remote rainforest where students and professors (all animal characters) conduct research on saving their natural habitats. The primary curricular challenge is to uncover the cause of a sickness that has caused the closure of WU. Game missions require players to read science texts to gather information and develop science understanding to resolve the cause of the sickness. A number of in-game challenges test the players' knowledge, monitoring ability, ability to summarize, and comprehend multiple sources. Meanwhile, players have access to numerous learning scaffolds that help track their progress in the game. The in-game texts vary both in length and structure, as some are topical and informative, and others will require interpretation of data, charts, and graphs. At each site players independently read texts before undergoing challenges to check for understanding. Responses from summarization, knowledge, and multiple-source comprehension challenges are assessed and translated into categorical game-based scores as badges and be presented in Mission Progress screens as feedback.
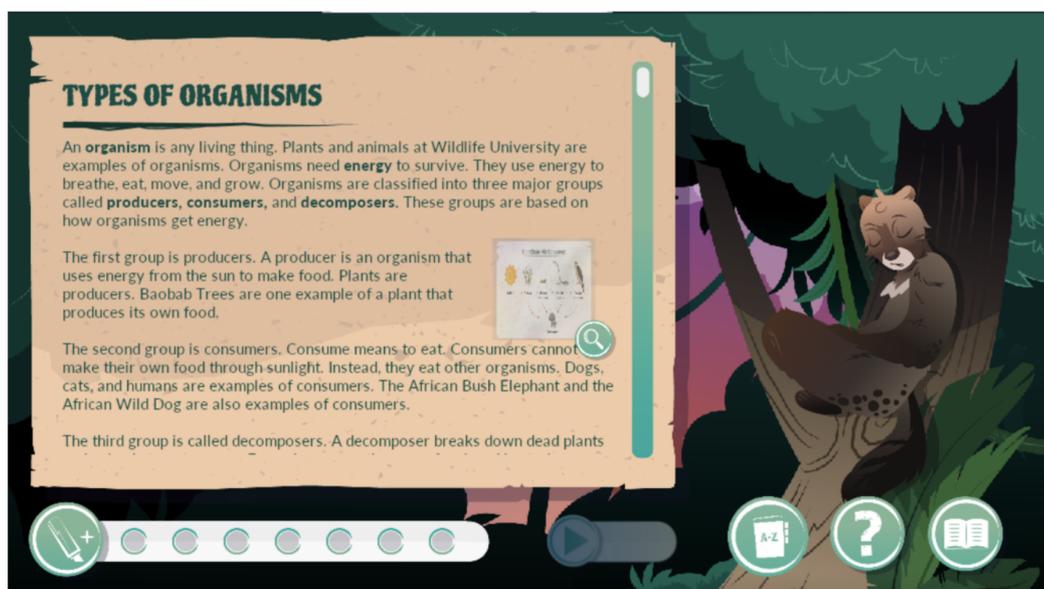

Figure 1. Missions with Monty text interface

1.1 Current Study

The purpose of the current study was to inform further design and development of a GBLE to engage and support MLs reading and science. Thus, the current investigation focused on MLs perceptions after exploring MISSIONS WITH MONTY. An interview study with grade 5 learners whose primary language varied examined how playing the existing version of MISSIONS WITH MONTY helps them learn science and impacts their engagement in reading science texts. After playing the GBLE students were asked about their preferences for reading science within MISSIONS WITH MONTY and attempted to get at potential avenues for improving the GBLE. Our research team visited two schools and conducted the interviews after students played a portion of MISSIONS WITH MONTY.

2 METHODOLOGY

2.1 Participants

Twenty eight fifth‑grade students (ages 10-11) from two schools in North Carolina, USA participated in this qualitative study. Demographic totals at these two schools were: 14% White, 29% Black or African American, 57 % Hispanic or Latin American. Given the intent of the study, it was important to have the voice of multilingual learners. Participants included 18 multilingual learners, primarily Spanish-English learners, and 10 monolingual English learners. The sample included 16 male and 12 female students. Care was taken to interview representative students based on teacher judgments of student reading levels to maximize student voice. This included 12 students rated as 'below grade level,' 9 students rated 'at grade level,' and 7 students rated 'above grade level.' Ethical approval was obtained for the study from the Institutional Review Board at North Carolina State University.

2.2   Materials

The interview protocol questions addressed whether participants they would become better at reading science texts if they played more of MISSIONS WITH MONTY; if they preferred learning science from MISSIONS WITH MONTY or their regular class instruction; their interest in being able to play the game at home; their favorite part of the game; their least favorite part of the game; and their most challenging aspects of playing. Participants also had the opportunity to describe what they would change about MISSIONS WITH MONTY. MLs were also asked questions addressing their perceptions of language supports and scaffolds that may benefit game play. First they answered whether there were language barriers in their game play. Follow-up questions considered how vocabulary supports, translation, and the role of pictures may impact their experience and learning from MISSIONS WITH MONTY. Although structured, some variance in follow up questions was anticipated as students' language experiences varied.

2.3   Procedure

The study was approved by the University Institutional Review Board and the local schools. Further, parental consent and student assent were secured prior to the interviews. Interviews were conducted at the school site during regular class time. Learners had previous exposure and gameplay with MISSIONS WITH MONTY in their classrooms, which served as foundation for the study. The amount of gameplay varied, however most students progressed through at least the first of three Missions in the GBLE. In order to contextualize the experience, students were provided with an additional problem related to an invasive insect impacting the ecosystem for game characters (elephant shrews). Students were introduced to the problem before playing MISSIONS WITH MONTY and were asked to provide solutions after covering the producers, consumers, and decomposers curriculum in the GBLE. Participants in the current study had not previously played MISSIONS WITH MONTY or provided feedback on the GBLE. Interview time varied, but interviews generally lasted about 5 minutes each. Interviews were recorded with personal cell phones and were later transcribed using a recording App for analyses.

3   RESULTS

Two researchers conducted analyses of the data. To analyze the data all transcriptions were initially independently read. A spreadsheet served to structure the initial analysis. Fields that represented each of the primary questions from the structured protocol were established with columns for follow up notes. Each participant represented a row. Researchers discussed each field and took detailed notes and quotes from the interview transcript representative of the response to each question and any follow up question. Additional fields allowed for observations and emergent themes as the researchers read and discussed each transcript. The result was a systematic representation of the students' responses to the interview questions for further analyses. Examination and discussion based on the representation followed with the researchers reaching consensus on conclusions drawn from the data for each element of the interview. Findings follow with pseudonyms used to represented student cases.

First, regarding whether participants *believed they would become better at reading science texts if they played more of MISSIONS WITH MONTY*, the vast majority of students replied 'yes' ($n = 22$) or the equivalent of 'likely yes' ($n = 5$), with only two students suggesting they were unsure or no. Students reported learning science and also learning about reading. For instance, one student, Javier, reported his excitement about learning about main ideas and stated, "Finding the main idea. That was my favorite part." When queried about whether they preferred *learning in class versus learning in the game*, students were mixed with more reporting learning in the game ($n = 19$) but some students reporting learning in class ($n = 7$). One student wasn't sure and one student suggested they preferred

learning from books. Not unexpectedly, students reported learning in the GBLE was more fun. Further, some students included their enthusiasm for learning. For example, Kaiden shared his preference for playing, "like how you can like explore, play. It's like a game. I like games. And it's like, I like science, so it's just really fun." For those who reported preference for school learning, some explanations rested with comfort with school learning and as Jacob noted, "you can get help from the teacher" when learning in school. When reporting if they would *like to play the game at home*, results were mixed. Some students reported they would and others indicated they would not. Few students elaborated on their reasons for their preference. However, students who liked learning from the game were more likely to report they would play at home. For example, when Julio was asked he stated, "Yeah. So, me playing the game. It's like it's still fun. So, I would have fun at home playing the game and learning." Interestingly, one student reported he didn't do school work at home.

Turning to the parts of the interview that addressed *most and least favorite parts of the game and the most challenging elements*, results indicated two overarching themes across these questions: Game elements and features, and learning from the game.

Game elements and features: Students listed technology glitches as some of their least favorite and most challenging parts of playing MISSIONS WITH MONTY. Slow loading times, freezing, and interrupted gameplay were all cited as frustrations and challenges. Alternatively, game elements and features were also listed as favorite parts of playing the game. Some students reported the game narrative, introduced via video at the beginning of the game, and seeking to solve the main challenges in the game were their favorite. Mario for example stated that his favorite part was, "When Like, I'm trying to discover like, what happened to the lizard." Others pointed to the game characters and scenes within the game. Aurelio, for example, shared that his favorite part was the characters and when asked which one, he identified the Elephant Shrew; while Jesse indicated his favorite part was when the student gets to meet the Eagle character.

Learning with the game: Some students reported a dislike for reading overall. They reported the passages were long and there was a lot of science to learn from the game. Others noted completing the highlighting challenge was difficult and their least favorite. While the highlighting challenge was most noted, finding the main idea and the need to reread to learn from the passages to answer questions were also mentioned. Other students reveled in the reading and the learning of science within the game. Students reported they enjoyed learning new things and answering the questions. One student, Angelina, noted that her favorite part was when, "We had to answer the questions about the ecosystem and stuff".

Of particular interest in the study was how students responded to the language use in the game. When prompted some students reported the vocabulary was challenging. Some reported that more pictures would support their learning from the game. Regarding translation of the game to Spanish to support multilingual Spanish/English students, students were mixed. Some were not interested in a translation, while others thought it would be beneficial. Two themes emerged from the questions about translating the game. First, several students reported it would be good to translate the game for other students but that they would use the game in English and not the translation. Second, additional students reported that they would use a translated game to support their use of Spanish as they were motivated to be better Spanish readers.

4 CONCLUSIONS

This study served to inform the iterative design and development of MISSIONS WITH MONTY with the intent to further develop the game to support multilingual learners reading comprehension of science texts and science learning. Findings from this initial study of structured interviews with a sample of fifth grade students who were previously exposed to the GBLE provide context for further game development and additional future interviews. Findings that emerged from the data were both expected and surprising. We had anticipated that learners would report that they learned from playing the game. Our previous quantitative studies [10,11] have determined that students learned science content and became better readers by playing MISSIONS WITH MONTY. It was gratifying that students also reported they learned from playing the game. While many students reported they preferred gameplay to in class learning, others reported they preferred to learn the science content through traditional instruction. This could be anticipated, as students reported in the interviews that they relied on their teacher to support their learning in the classroom and that learning in classrooms felt more comfortable. As a serious education game MISSIONS WITH MONTY provides extensive curriculum and demands learners sustained attention, and effortful learning. While teachers manage game assignment and technology, their role is minimal to

students' game play and learning within the game. It may be that as some students were challenged to learn from the game, they desired additional supports, future game development can address this need through enhanced mechanics. Previously, some students had expressed a desire to play MISSIONS WITH MONTY at home. Therefore, we asked students in the current study if they would play the game at home if given the opportunity. Students' responses were mixed with some suggesting yes they would and others indicating they would not. The protocol did not ask students to elaborate but we can speculate why some learners reported they would or would not play at home. Some students reported they liked the game and learning from the game and were excited about learning science and, unsurprisingly, many of these students reported they would play at home. As noted, few students expressed a reason for not wishing to play at home but it is possible that access to computers and high speed internet as found at school, may not be available in all homes as approximately 15% of homes in the state of North Carolina do not have internet [15], which would lead some students to indicate that they would not play at home.

When students responded to their least favorite parts of the game, the two main themes: technology and learning from the game were not surprising. The reported technology glitches, such as load time and game freezing frustrated students. For some, elements such as the highlighting challenge that support students' learning from the game but are difficult, potentially placing high demands on cognitive load, represented their least favorite aspects of the game. As anticipated, those who reported game elements as their favorite parts of playing MISSIONS WITH MONTY often cited characters and the game narrative. It was somewhat less anticipated that students would revel in what they learned about science and reading from the game. MISSIONS WITH MONTY presents a significant amount of curricular content. Students may not realize as they approach the game that learning within the GBLE will be challenging, however, it is not surprising that they reported learning from the passages and engaging the learning strategies was challenging.

Of particular interest in this initial study was how students responded about language within the GBLE. Some students reported challenges with vocabulary, regardless of language status. This was not surprising as the game includes science vocabulary that may be new to students. Those students, particularly MLs, suggested translation as noted, was not surprising. Of particular interest in translation for some was to support their reading and learning in Spanish. GBLEs such as MISSIONS WITH MONTY provide unique opportunities to leverage MLs' language assets and strengths. This study is a first step in exploring how game design and development can enhance affordances for MLs.

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