It Just Makes Sense:

Cognitive Development, Instructional Design, and Technology-Based Curriculum

Mary E Byrnes
June 15, 2014
Non-Licensure Master's Capstone Proposal
Peabody College, Vanderbilt University

Abstract

This capstone employs research from cognitive architecture to analyze, critique, and inform a form of digital scaffolding called Immersedition. Specifically, this capstone explores the way in which Immersedition and Immersicons account for the learner, context, curriculum, and assessment. Findings include the responsiveness of the text to individual student needs through the interactive journey the text provides by allowing students to push beyond the barriers of the narrative usually proposed by reading in a traditional format. Implications for the future suggest a focus on developing skills to create self-regulated learners.

Introduction

The ability to effectively work with tools-mental and physical-is necessary for school age children to develop skillsets that work with the content to further engage the learner in higher order thinking (Vygotsky 1980). The learner first engages at a social level, which is followed by an individual level of engagement. With the new wave of technological implementation in classrooms and a push for literacy across domains, there is a shift in the focus of instructional design from traditionally taught content to teaching mastery of skills, or the acquisition of tools, as Vygotsky would suggest.

After graduating from undergrad at Vanderbilt in Peabody College, I was looking for an internship, before attending graduate school, that related to my undergraduate studies, but also challenged the current norms of education, specifically curriculum. Over this past summer, I worked for Immersedition, a curriculum design company that specializes in the interactive book experience through use of technology, initially as apart of an independent study in curriculum. Deeply interested in the decision making of curriculum especially as it applies to new technology, I worked with Immersedition creative director and founder, Amanda Havard, to explore how her interactive book platform and methodology is applicable to the teaching of classic literature and teachable texts. Watermarks, or "Immersicons" (see Figure 1) identify the teachable moments within the text that denote a moment of potential engagement for the reader. The reader can touch the watermark and an image or description pertaining to that section will pop up in a smaller window. In my time with the company, my projects included the researching and writing of two pilot excerpts of "Immersicon" teachable touch point content for two widely taught American novels, as well as research on technology, methodology, the Common Core, and

developmentally appropriate curricular principles as it pertained to the company's plans of moving forward into educational texts with partner publishers. This experience underscored the need for further research to better understand the possible cognitive implications for students as a result of reading digital texts. The cognitive shifts would ideally move away from decoding and fluency and move toward higher order thinking skills, such as being able to evaluate and create rather than recall basic facts.

Figure 1: A page from *The Great Gatsby* mock-up presenting a character profile of Jay Gatsby based on what the reader knows at this moment in the text.

In the following, I begin by describing the research centered on cognitive development and studies about how the senses are incorporated in processing information as a means to organize content as it is absorbed into the brain. Using Sweller's (1998) work on cognitive architecture and instructional design as the foundation for my work, I will argue that more deliberate measures need to be made in the digital tools teachers provide students in terms of opportunity to engage and interact with the text itself. Specifically, my capstone will focus on the individual interactions the learner engages in with the text. The learning context is informed by the individual learner, but also by the learning community created in the classroom. By identifying individual differences and considering prior knowledge, the learning context and engagement with the Immersicons is enriched as a whole because there are multiple perspectives that must be considered and responded to in an appropriate matter. The curriculum is the piece that I created, with Amanda's help, and it was shaped by what I learned from my coursework at Peabody and what I learned from my student teaching experiences. With a focus on technology, curriculum provides an even more expansive opportunity for teachers to give students access to the texts they are consuming, but also other topics that the text highlights, such as history, art, and popular culture. Furthermore, the Immersedition format helps the text to evolve into something more than just a one-dimensional reading that is often prevalent in many classrooms. It offers students the opportunity to access information beyond the text itself without having to search or navigate through the Internet, while trying to read the text. Assessment was not a specific focus of this particular stage; however, it was considered that formative assessments would be incorporated throughout the reading of the novel followed by a summative assessment that reflects the skills students developed

by interacting with the text in this manner. Focusing on the learner and the learning context allows for more flexibility if the curriculum provides a solid foundation from which students can build upon and are able to enact near and far transfer in their studies. Students would be able to collaborate with their peers, but also would be able to associate and make connections between content areas.

Learner

In order to understand how to best institute the teaching of tools to a 21st century learner, it is necessary to first understand that there is a limit for each individual learner due to biological restrictions on cognitive load. Information processing theory, for instance, suggests that the learner is exposed to information from all five senses that is absorbed by receptors into the sensory memory (Wolfe, 2010). Because there is so much information being absorbed at a single moment, the cognitive load is a concern, because only a limited amount of information can be held at this time. From the sensory memory, the information is processed into the working memory where it is immediately organized into the long-term memory, or forgotten and not transferred into the long-term memory. According toe Sweller, van Merrienboer, & Strass (1998) "…knowledge about working memory limitations suggest humans are particularly poor at complex reasoning unless most of the elements with which we reason have previously been stored in long-term memory" (p.254). Complex reasoning requires skills that are transferrable across contexts and are not necessarily content-specific. Complex reasoning would be considered a skill that would be stored in the long-term memory that could be applied to new information that is trying to be assimilated from the working memory.

In other cognitive research, the term schema is used to describe a learner's ability to make connections between related materials. A schema is a body of knowledge stored in the long-term memory that operates based on connections. Sweller et al. (1998) suggest, "Learners who have a more automated schema have more working memory capacity available to use the schema to solve more sophisticated problems. Similarly, a reader who has automated the schemas associated with letters, words, and phrases has working memory capacity available to devote to the meaning of the text…" (p. 257). Because research has found that schemas function based on connections with prior knowledge, the load that instructional designers should consider becomes based on the skillset that the perceived classroom of students will have that allows them to interact with new content using schemas they have already constructed with new media skills.

The interactions that are fostered through the use of multimodal and scaffolded texts are initially formed between the reader and the text. Hutchinson, Beschorner, and Schmidt-Crawford (2012) discuss the International Reading Association (IRA) and their comments about today's learners suggesting:

> IRA (2009) issued a position statement asserting that: to become fully literate in today's world, student must become proficient in the new literacies of 21st-century technologies. IRA believes that literacy educators have a responsibility to integrate information and communication technologies (ICTs) into the curriculum, to prepare students for the futures they deserve (n.p.) (p. 16)

The role of the learner has shifted to be responsive to the needs and requirements expected from a member of today's society in terms of being a 21st century learner. Students today

are exposed to technology from very young ages and are consistently using it as they grow physically and cognitively. For instance, Shamir (2013) has found that "…21% of all children aged 2 years and younger, 58% of 3- to 4-year-olds, and 77% of 5- to 6-year-olds have had some experience with computers, often on a daily basis" (p. 96). While there is not a one hundred percent guarantee that students will come into the classroom having the basic skills to navigate popular technology and apps, such as Facebook, Twitter, and Google, the statistics show that these are considerations that need to be anticipated in instructional design.

The Immersedition prototype understands the learner by allowing for the scaffolding of reading comprehension skills, in addition to other information relating to the text to enhance the reading experience based on each individual reader. These prototypes present the information in a manner that attempts to reduce the cognitive load of the learner by marrying text and graphics to promote understanding and comprehension. Kalyuga, Chandler, and Sweller (1998) discuss cognitive load theory suggesting:

> …learning might be inhibited when learners must split their attention between and mentally integrate text and graphics because the integration process might overburden limited working memory capacity. However, when textual information is presented in auditory form, mental integration with a diagram may not overload working memory…(p. 353)

The touch points, or "Immersicons," through which students can engage include notes about setting and characters, discussion moments, literary devices (See figure 2), and moments of important historical significance. Students are not forced to engage with each "Immersicon," or touch point in the text, but are able to engage in a reading experience.

Digital texts seek to redefine the reader as learner rather than decoder. The supports and scaffolds are in place to aid struggling readers; however, the focus becomes less on fluency and word-for-word reading and becomes more about making sense of the text (Dalton and Proctor 2007). The Immersedition methodology is universally present for many texts because it operates by engaging students. The idea is that the moment the student touches one of the Immersicons, a point of engagement with the text has occurred.

Another key factor related to the learner in the design of Immersicon is the individualization of the journey that is a result of the reader's decisions based on their interest and curiosities. Another way to procure engagement is through curiosity, which is described by Arnone, Small Chauncey, and McKenna (2011) in that "…technology can play a role in stimulating curiosity and interest and in facilitating and sustaining purposeful engagement. Moreover, technology can play a role in triggering and addressing personal, situational, and contextual factors that support autonomy and competence and engender active, deep learning" (p.182). This methodology does not do all of the thinking for the learner, but provides key points in the text to direct the thinking. Arnone et al. (2011) views students as almost ambassadors of their own learning stating, "The social and technological contexts are important in that the student may engage others in her quest for information; perhaps sharing her resources and requesting input using social media tools, and in doing so, stimulates peer curiosity in the topic and its exploration for answers" (p. 187) The nature of much of the technology used by learners today is a form of connecting with other people using social media or other forms of communication. Instructional designs should reflect these same goals inside the classroom in an effort to stimulate collaboration and conversation among learners, rather than only fostering individual

learning experiences. The emphasis is focused on leaners as creators and the importance of the learning environment, or learning context, as a product of a purposeful design that supports the learning goals.

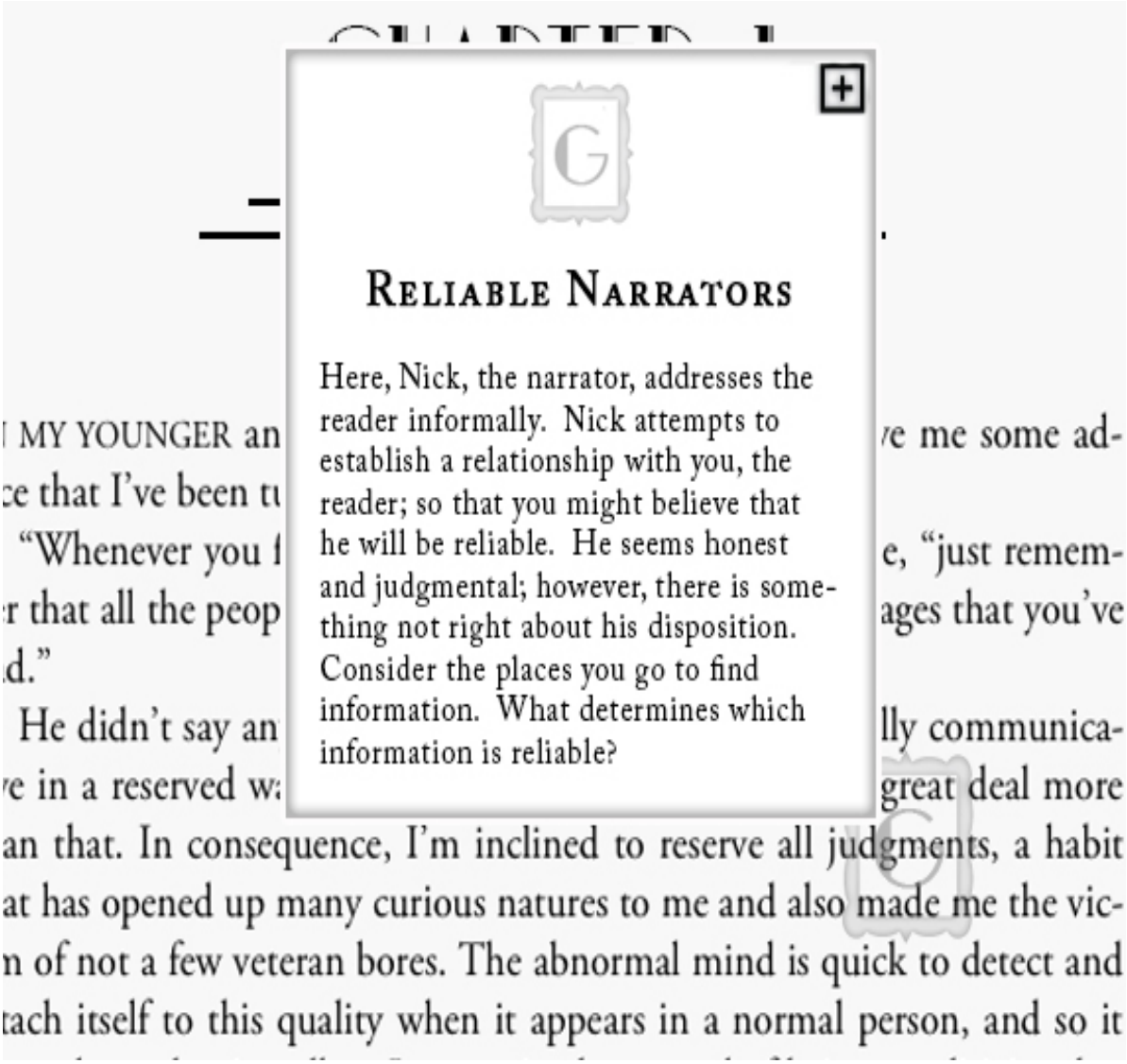

Figure 2: A page from *The Great Gatsby* mock-up presenting Nick as a reliable narrator, which includes a definition and a question to consider.

Learning Context

The type of knowledge learners are expected to take ownership over largely determines the context in which the learning takes place. The types of knowledge students

are expected to learn are both declarative and procedural in that they are required to know how to complete the activity or task, while also constructing meaning thinking critically about the content based on their prior knowledge (Ashman and Conway, 1997). Technology and new media offer teachers the ability to differentiate instruction because programs, like Immersedition, allow students to take charge of their own learning and make connections with the text based on their prior knowledge and experiences. Furthermore, the unlimited capabilities of the current technological advances create limitless opportunities to create a learning context that is both engaging and challenging for learners. Self-regulation requires students to take responsibility for their learning and to learn to evaluate their learning and progression towards their goals. In discussions about self-regulated learning, Shamir (2013) proposes, "SRL is characterized by the extent to which the students are active participants in their own learning processes, that is, how much they consciously set goals; take part in strategic thinking; plan, monitor, and evaluate solutions (metacognition); invest effort to enhance motivation and a sense of self-efficacy; as well as seek help (Pintrich, 2000; Zimmerman, 2000)" (p. 98). The learning context, or learning environment, is centered on the learner, rather than the teacher.

Using the Immersedition as a model, the learning context is largely created by the Immersicons that were selected to be part of the text. While the Immersicons are based on the opinion of publishers and English teachers, the context in which they are presented allows opportunities for learners to push beyond the information presented to potentially develop their own touchstone moments, or to even challenge the text or Immersedition. The eventual goal of the instructional design is to alleviate non-essential information entering into the cognitive load to create room for the types of critical thinking that are

expected of students engaging with both fiction and informational texts of all kinds. According to Dalton and Proctor (2007), "In a digital context, the relationship between reader, text, and activity can be changed in ways that extend the capacity of the reader and transform the text to take on teaching and learning roles" (McKenna; Strangman & Dalton) "(p. 3). Students become agents of their own learning and have the potential to become liberated by the power of their ideas as a result of these engagements and their curiosity combined with critical thinking skills developed while reading. The learning context created by both the environment and the opportunities the curriculum affords are both products of deliberate decision making in terms of instructional design.

Curriculum

With the newly imposed Common Core State Standards, educators are faced with new challenges regarding curriculum and instructional design. While the execution of these standards appear to be somewhat rushed and uninformed from district to district, the skills they require and the progression from grade to grade provides a map for administrators and teachers alike of expectations for learners at each grade level. Individual teachers have the power to implement how their students achieve these skillsets in their classrooms. Across most, if not all reading standards, the common themes are interaction and engagement for each learner. While it is important for students to be curious and to have meaningful interactions with the texts based on prior experiences, it is more important for students to have interactions that will lead them to a deeper, critical analysis. Teachers are helping students develop tools they need to succeed, but these tools need to be practiced and used consistently.

The Immersedition texts try to help merge the critical thinking skills with the skills that the 21st century learners are bringing into the classroom and need to carry with them into careers. Teachers need to be deliberate in their planning with forms of new media because there are different skills required to navigate and engage with these practices. Integration of technology needs to support the learning objectives and provide students with opportunities to exhibit a deeper engagement with the new literacies (Hutchinson et al., 2012). The Immersedition Immersicons allow students to engage with the text and teach them how to be effective readers without forcing them into a specific learning preference. While there are some ideas in the text that need to be discussed as a whole class, the Immersicon allows the students to have autonomy in their reading, while engaging their interests. Shamir (2013) discusses autonomy noting, "Conscious student activation of metacognitive processes has crucial implications for teaching because the responsibility for learning is shifting from the teacher, as the chief mediating figure, to that of the student" (p. 98). In terms of curriculum design, this creates more work for the teacher at the beginning of the units to ensure activities are building upon the students' needs; however, the actual instruction time the teacher would usually be given for direct instruction is exponentially smaller and these designs allow for more student collaboration, similar to that of social networking.

Assessment

Assessments using technology and digital media are not as developed; however, programs, like Immersedition, afford teachers opportunities for formative assessments as students read. Assessments using technology and digital media are not as developed; however, programs, like Immersedition, afford teachers opportunities for formative

assessments as students read. Self-assessment is a skill that is developed through metacognitive practices and should be considered a goal for readers who do not feel as though they are in control of their own learning or do not feel that their skills are adequate to accomplish their goals (Dalton and Proctor, 2007). Metacognitive strategies allow students to think about their thinking through visualizing and questioning while reading. Metacognitive strategies are developed over time and can be applied to multiple content areas. Formative assessment is a key to learning because they allow for students to have time to prepare and to assess their own progress based on the feedback they receive from the formative assessments, which translates to becoming lifelong learners (Rushton, 2005). Because formative assessments allow for assessments to occur over the course of the unit, students are given multiple opportunities to essentially master the skills that will be asked of them on the summative assessments.

In addition to metacognitive strategies, formative assessments also allow students the opportunity to receive feedback from the teacher. Feedback is dependent on the ability of the teacher to provide constructive feedback and the ability of the student to receive the feedback and make appropriate revisions to foster improvement (Rushton, 2005). Learning goals that are clear and reachable for students must preface the process of self-assessment through metacognition and feedback. In terms of aiding students in generating feedback, it is important to consider that students will not engage in a thorough self-assessment unless they see the long-term benefits, including better grades, and practice revision and the process of self-regulation (Andrade, 2010). The feedback is dependent on how it is used once the student has received it. By including formative assessments throughout the unit, the students can practice utilizing the feedback, while developing a

better sense of the teachers' expectations, which will allow the students to begin to set goals for themselves.

While there can be supports and tools handling formative assessment for reading comprehension and engagement with the text, summative assessments are not a component of this yet. The instructor develops assessments based on the goals and objectives of the overall unit; however, it becomes more difficult to structure these assessments when each reader is attending to different topics located within the text. Immersedition lends itself to a form of standards based grading because it is focusing on developing transferrable skills, while eliciting student engagement in reading canonical texts.

Implications

The increasing popularity of using technology in the classroom affords teachers and publishers opportunities to recreate curricular materials that reflect the needs of 21st century learners. Shamir (2013) suggest these materials "…need to focus on enhancing students' ability to be independent, self-regulated learners able to make efficient use of metacognitive processes in the technology-saturated environments that require continuous autonomous decision making regarding the acquisition of information" (p. 100). The "shortcuts" that technology can offer for students with issues regarding reading fluency and word recognition alleviate some cognitive pressures that are then replaced with a focus on reading comprehension and critical thinking. Specifically looking at Immersedition, the access to the relevant information is already embedded in the text, which allows the student to save time when trying to build context and comprehension around the text. In order for teachers to effectively implement technology, specifically

scaffolded e-texts, like Immersedition, in the classroom, they need to be experts in their content, but also be aware of their students as learners and as members of the larger classroom community. By assessing prior knowledge and building a safe environment, teachers can better structure formative assessments throughout the unit to ensure students are reaching goals and objectives of the unit. Immersedition allows for students to individualize their learning experiences as they relate to their personal interests. The Immersicons do not open unless the student touches the watermark. For example, if a student doesn't care to learn about the fashion during the time *The Great Gatsby* takes place, the student does not have to select to view this Immersicon. Hutchinson et al. (2012) proposes an ideology for teachers commenting, "TPACK (Technological Pedagogical Content Knowledge) emerged as a framework for identifying and understanding the complex interplay of teachers' technological knowledge, pedagogical knowledge, and content knowledge and how these knowledge bases influence how a teacher effectively integrates technology into classroom instruction" (p. 16). In considering the trajectory for students, a major goal of instructional design with the 21st century learner in mind is developing skills and abilities so they become self-regulated learners, which will push them to be able to collaborate with others inside and outside the classroom. While the assessment piece of Immersedition is not fully developed, it still affords the teacher opportunities to constantly assess these skills and provide supports, in addition to the supports from the e-text, to either improve skills or continue practicing skills useful in metacognitive processes. Teachers can track which Immersicons students select and can receive feedback about how long it is taking each student to read the texts based on their level of engagement with the Immersicons. Students should develop portfolios of their

learning progress that can also provide them insights into what they have been assessed on and how far they are at reaching their anticipated goals for the year. Furthermore, utilizing technology in the classroom is a shared responsibility between teachers and students. In order for effective implementation, students and teachers need to be reflective about technological practices and ensure that the appropriate tools are being used to accomplish the objectives.

Future Considerations

The topic of technology implementation in the classroom is growing in popularity due to the skills required of students to assimilate into the real world. There are questions about the relationship between publishers and educators regarding the most effective teaching practices and how technology will best be incorporated considering the new Common Core State Standards. The involvement of educators in the publication and editing process of these companies should be researched in order to develop an appropriate relationship between experts in the field and the publishers creating the content. Action research models could help teachers develop their practices, while learning to incorporate technology most effectively. Teachers could model the importance of self-regulated learning, as supported by action research, while also involving students in the evaluation process. The most valuable research will be actually utilizing the e-texts and other technology in the classroom with students to receive feedback quantitatively and qualitatively. The students, like the teacher, could engage in similar roles of action research that are more focused on self-regulated learning and metacognition as they become responsible for themselves as learners. Furthermore, the topic of assessment regarding using e-texts in classrooms and how assessment needs to evolve to support the

skills required of 21st century learners would be a worthwhile topic for research, as assessment is a crucial component of the learning process and the education system.

References

Andrade, H. L. (2010). Students as the definitive source of formative assessment. *Handbook of formative assessment*, 90-105.

Arnone, M. P., Small, R. V., Chauncey, S. A., & McKenna, H. P. (2011). Curiosity, interest and engagement in technology-pervasive learning environments: a new research agenda. Educational Technology Research and Development, 59(2), 181-198.

Ashman, A. F., & Conway, R. N. (1997). *An introduction to cognitive education: Theory and applications*. Psychology Press.

Dalton, B., & Proctor, C. P. (2007). Reading as thinking: Integrating strategy instruction in a universally designed digital literacy environment. *Reading comprehension strategies: Theories, interventions, and technologies*, 423-442.

Hutchison, A., Beschorner, B., & Schmidt-Crawford, D. (2012). Exploring the use of the iPad for literacy learning. The Reading Teacher, 66(1), 15-23.

Kalyuga, S., Chandler, P., & Sweller, J. (1999). Managing split-attention and redundancy in multimedia instruction. Applied cognitive psychology, 13(4), 351-371.

Rushton, A. (2005). Formative assessment: a key to deep learning?. *Medical Teacher*, *27*(6), 509-513.

Shamir, A. (2013). Cognitive Education in the Digital Age: Bridging the Gap Between Theory and Practice. Journal of Cognitive Education and Psychology, 12(1), 96-107.

Sweller, J., Van Merrienboer, J. J., & Paas, F. G. (1998). Cognitive architecture and

instructional design. Educational psychology review, 10(3), 251-296.

Vygotsky, L. S. (1980). *Mind in society: The development of higher psychological processes*. Harvard university press.

Wolfe, P. (2010). *Brain matters: Translating research into classroom practice*. ASCD.