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Application of Problem Based Learning and Mastery Learning to Multimedia Education

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Introduction

It cannot be ignored the desire of many employers, and learners for that matter, for education to provide them with the necessary talents and skills that demonstrate great depth of knowledge and application. Attaining this goal places great demands and requirements on curriculum developers and instructors whose task is to structure learning experiences for maximum retention and application (Putnam, 2001). We must realize as educators that this task requires not only the teaching for recitation of knowledge, but also the ability to explain and apply knowledge in great depth. In addition, should teaching content knowledge not also charge the educator with the task to educate to the abilities of the greater classroom population? Anyone reading this article might acknowledge personal experience that if they were to plot the overall learning of a classroom according to the traditional methods of education on a normal curve, some discomfort would be felt with the fact that only a small portion of learners acquire the knowledge and demonstrate application to a great extent. Beyond the teaching for knowledge acquisition, Block (1980) contends that if we are to teach, perhaps we should focus on improving students learning for long term social and personal prosperity. For without doing so we truly fail to see the greater need to promote a community and culture of lifelong learning. Depending on the source, teaching to promote lifelong learning can be more valuable than the content itself. However, the mastery of content exists as only one component of the needs for learners.

There exists great discussion in the realm of knowledge acquisition as it relates to transfer. The knowledge that learners acquire should be applied in new ways, new situation, or in familiar situations with different content (Schunk, 2012). We may often forget that even in relaying information to given learners via textbook lessons, or hypothetical scenarios, what may often be lost are the practical application of the knowledge to new situations. Driscoll (2005)

reminds the educator "Acquiring specific prerequisite skills and knowledge within a content discipline is important. But so is solving problems that require learners to go beyond their current skill and knowledge levels," (p. 256). So where does the context fall within our given situation? Even the mastery of any material is worthless without thought of how to promote positive transfer of information to different contexts (Mayer, 2008). Therein lies the second challenge of the educator; how is the application of new knowledge foreseeably transformed into transfer for alternate contexts or situations? Without considering this, the end result of educating learners toward the end of mastery produces very intelligent learners with little thought of knowledge application. The consideration for context and transfer only goes so far as we examine the further needs for learners.

Certainly not the least important, but one additional concern for educators working toward masterful students with abilities to apply knowledge in multiple contexts, is the concern of learners being able to work in close tandem in the production of new knowledge. For years leading up to our current state of educational environment, it has obviously been the concern of educators to produce well rounded learners well in control of cognitive activity. With the current state of individual learning and assessment, the gap between those that are able to learn and perform and those that are not, continues to damage an instructors' ability to effectively deliver instruction with the upmost quality given the incredible gaps produced by the current educational system. The supposed fix to this situation is the establishment of nationalized curriculum standards passed forth by governmental and accrediting bodies that require the school system to be accountable for individual learners. The response to this situation is often times teachers involving themselves in the practice of "teaching to the test" where learners only learn so much as to perform well on a standardized assessment. Does performing well on a standard exam

really prove the ability of a learner to work in the real world? As a result, there is much criticism of educational systems inability to prepare students for the workforce or higher education (Zimmerman & DiBenedetto, 2008). In essence, there are issues with this system that need to be corrected.

The previous paragraphs pose for the educator a vast multitude of questions. The most likely of these is perhaps "What do you propose we do about it?" Within the field of multimedia, this question poses a particularly difficult problem. Many educators within multimedia deal with classrooms that include learners from a variety of different disciplines and educational backgrounds. With this stated, Neo and Neo (2001) found multimedia graduates are often lacking creativity, communication skills, analytical and critical thinking, and problem solving skills. As many of these learners are subject to vetting by industry upon graduation, it remains in our interest to prepare learners so that they are adaptable to the needs of industry. How can this be accomplished for such a diverse classroom? Recently, methods using problem-based learning have shown success in areas of health education and law. With the focus on the context and authenticity, it has been witnessed in a learner's ability to acquire and apply knowledge to multiple situations. As for the conquest for complete knowledge of material, mastery learning was abandoned due in part to the massive record keeping required and time constraints it required (Guskey, 2007). However, its track record during its time proves the possibility of being able to help all learners learn excellently. Given the technologically advanced nature of many record-keeping systems, perhaps it is time to give mastery learning a second chance. In the following pages, an effort will be made to further elaborate on the tenants of both problem based learning and mastery learning. In addition, examples of where these efforts were demonstrated with success will be included. Finally, a design where these two elements have been combined in

an effort to improve learning within multimedia education will be discussed. The entirety in its final product should provide educators with an effective model of information to assist in the implementation of these models in tandem in a course where learners interact with the development of multimedia.

Problem Based Learning

To assist in understanding the support of problem based learning, we should start with a practical understanding of what we encounter in the real world. In reality, the problems that we encounter are difficult and admittedly messy. Many times there may not exist a single correct solution for the given problem for an individual to apply. Does this sound familiar to something that an educator may have encountered recently? When searching for the solution, we might seek the assistance or sage advice of a colleague or even a larger group of individuals for plausible answers. During these sessions we may look at the problem in much greater detail, plan the solution, and divide tasks. It may be necessary that we do a bit more independent research to figure out what is needed to solve the issue. When we have finally applied the knowledge and information to fix the given problem, we typically evaluate the outcome and hopefully file this away in our mind the next time similar problems occur. This real world thought scenario perfectly describes a problem based learning type classroom. To put the characteristics of problem based learning more succinctly, Williams et. al. (2007) list the features of PBL as:

1. Use simulations that simulate reality
2. Encourage collaborative engagement between learners
3. Allow student control over aspects of the learning process such as goal setting, timetables, etc.
4. Encourage independent study outside of the classroom

5. Student reflection about the process as a whole

As easy as it sounds to pose messy problems for a group of learners and allow them to "have at it", the cautious optimist must inquire as to if there are any items to look out for in the classroom. Arts et. al. (2006) reminds us that being able to solve these ill-structured problems may require:

1. Possession of a substantial amount of declarative and domain-specific knowledge
2. Good organization and use of one's knowledge
3. Effective reasoning
4. The ability to extend one's knowledge and skills beyond the context in which it was acquired.

More succinctly, an introductory multimedia course would likely not be able to handle to cognitive or organizational requirements to engage in problems where multimedia design solutions are needed. Most educators would find even some cases at an intermediate level where learners are not cognitively prepared to handle the demands of problem based activity. The demand is so great in the case of multimedia education as automaticity of skills is required so that the learner does not experience cognitive overload as they are trying to process new information while operating new tools (Mayer, 2005).

With problem based learning it is even foolish to assume that any simple problem will set the stage necessary to create an engaging and meaningful learning experience. The development of the problem requires multiple steps that Putnam (2001) lists as:

1. Selecting a problem that is authentic and from a world the learner will understand
2. Selecting a problem that is interdisciplinary and may require probing of multiple knowledge bases

3. Selecting a problem that is ill structured and complex.

It is of critical note to recognize these needs when developing the problem, as selection of a problem unmatched to the learner or the environment may impede learning significantly. The last thing any educator wants is to create disconnect in an activity simply because the problem was only of interest to the educator and not the learners.

When qualified learners finally assume a well-designed problem, the educator can expect the learners to engage in the following processes, as listed by Putnam (2001):

1. The learners will bring their own knowledge to the problem and access what will be needed in solving the problem
2. The learners will generate initial ideas or explanations to solve the problem
3. The learners will attempt to search out information to support ideas or questions
4. The information that learners seek out will be analyzed to confirm or deny hypotheses
5. The learners will attempt to synthesis the information gathered
6. The learners will commit to answer the problem based on information gathered
7. The learners will identify issues to be studied
8. The learners will identify the resources that are planned to be used in the study
9. The learners will engage in self-directed learning

These processes in which the learner engages may require some independent thought as well as collaborative work. The collaborative or group component serves the learners well as they listen to alternate thought and perspective and undergo cognitive conflict that leads to the acquisition of new knowledge (Mayer, 2008). The instructor is not present as a supreme purveyor of knowledge unto the learners, but rather serves as a facilitator providing assistance, not answers (Schunk, 2012). We can ultimately infer from the entirety of problem based learning

the development of metacognitive, higher order thinking that comes about as a result of this process. Moreover, the approach to taking on realistic problems with the focus on context is something that can be appreciated by a number of industries. Strengths are apparent with the form and functions of problem based learning fully exposed, but clearly on the mind of the educator is the connection or possible usage of mastery learning. Exactly how does the work of mastery learning show promise in learner as multimedia designer based environments?

Mastery Learning

Truth be told, it is of the upmost concern of many teachers that at the conclusion of a course, that every learner be able to demonstrate to great extent the knowledge and skills that have been acquired over the time in the classroom. Admittedly, in the structure of classrooms that exist currently this is not the case. From the work of Bloom, Block, Keller, and Carroll we were exposed to the possibility that we could indeed produce learning in each individual that demonstrates superior knowledge. Schunk (2012) defines mastery learning as "a systematic instructional plan that has at its objective, students demonstrating high achievement," (p. 495). The fundamental concept of mastery learning stems from the idea that given greater amounts of time and supportive, corrective feedback, that a learner is capable of truly mastering the subject material (Guskey, 1980). This concept is not totally farfetched if we reflect on the models of many of our tutoring systems or how learners with disabilities are educated. See figure 1.

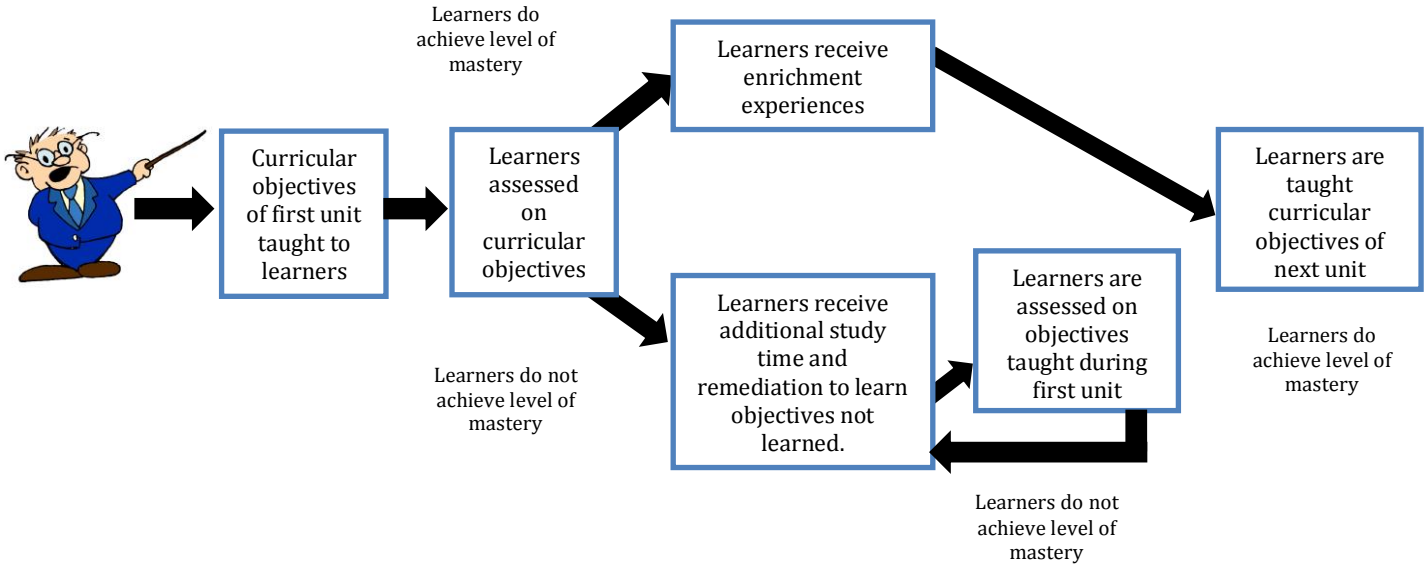

Figure 1. Model of mastery learning flow. Adapted from "Mastery learning: Applying the theory", by Guskey, T. R., *Theory Into Practice*, *19*(2), 104. Copyright 1980.

If we are to understand mastery learning, the above diagram will serve to provide the educator with a general picture. Although there exists multiple variations, mastery learning typically starts with the teaching of the educational objectives. Upon the instruction of these objectives learners are assessed. Depending upon the outcome of the assessment, learners are either directed into enrichment experiences or remediation. Enrichment experiences are developed for those learners that are able to achieve the mastery of the objectives after the instruction. These activities are meant to further the learner's knowledge on the subject matter. Those learners that were not able to attain the level of mastery necessary, go through remediation, receive additional time and guided direction. These learners will then have the opportunity to be assessed once again in an effort to try to attain the mastery goal. When the learners have all achieved the mastery goal, the instruction for the next unit is provided for all learners and the process continues (Block & Anderson, 1975).

Before migrating into the practical application of each model of learning, it seems necessary to elaborate on a few items regarding mastery learning. As one might be able to see, the amount of time and planning that goes into remediation and enrichment activities is significant. It is difficult for the educator to imagine developing not just one lesson plan per unit, but the possibility of several. In addition, significant time and effort must be exhausted in maintaining thorough records of each learner in the classroom. If the educator is truly able to assess until progress, this could require multiple types of examinations. This factor and time constraints are the likely causes of the declining popularity of mastery learning in education (Guskey, 2007). One factor that cannot be denied however, are the benefits in the learning outcomes for students despite the sizes of the classes, content areas, or settings of the classroom (Block & Anderson, 1975). Guskey (2007) further concludes from his meta-analyses that implementing these elements reduces the variation in learning outcomes and closes achievement gaps at multiple levels of education.

Effectiveness of Application of Problem Based and Mastery Learning

The effectiveness of problem based learning with multimedia design has numerous studies indicating its effectiveness. As a first example, Neo & Neo (2001) find that when students were grouped to develop multimedia projects, the learners found motivation in the challenge of the project, felt that they learned more regarding the development process, learned a great deal about group interactions, and learned more about the software and hardware. The investigators enforce this perspective in their findings of students being actively engaged in the learning process. As a second example, Arts et al. (2006) indicate that when learners are able to collaborate in a computer supported problem based learning activity; these groups can produce a greater number of inductions to help produce multiple solutions to problems. As a final example,

Min (2003) gives by far the strongest support for problem based learning within multimedia indicating that learners are better able to demonstrate higher creativity, better understanding of collaboration and planning, and testing projects. These results were found in studies of both middle-school and high school learners. With great support for problem-based learning evident, one ponders the effectiveness of mastery learning.

Similar to problem-based learning, the effectiveness of mastery learning has long been demonstrated. Guskey (1980) indicated that after implementing mastery learning concepts at Olive Harvey College, student achievement improved, class attrition reduced, and positive attitudes toward learning were witnessed by students and faculty members. As a second example, Guskey (1980) indicated that after implementing mastery learning concepts such as criterion-referenced assessment, effective record keeping, and the development of continuous progress curriculum materials developed in the Chicago public school system, teachers experienced improved success. Guskey (1980) further notes that once programs like this are developed, it is relatively easy for teachers to make modifications that fit their methods and practices. Where most of the examples provided by Guskey were limited to single classrooms and schools, the effectiveness of such a system have been seen with several million learners at multiple grade levels on an international level (Block, 1980).

The question is then how to effectively implement the concepts of both problem-based learning and mastery learning, into multimedia education and how specifically it would function. Specifically, what would an educative multimedia learning environment look like with these tenants in place?

Case Based Application

The issues that typically incurred with mastery learning related toward the excessive record keeping have for many been a barrier to implementing this model of learning in the classroom. As we move into the age of information storage and retrieval this has become less of a barrier. In tandem with the ability to efficiently create an electronic record keeping system, and practical project based work available for learners, both problem-based learning and mastery learning may effectively work in tandem.

An example of these two concepts working in tandem is taken from an advanced digital media course with college level learners where both of the tenants of problem based and mastery learning are engaged. Learners are required to develop for a real community customer a multimedia project for which they will use for their small business. Prior to engaging in this project, learners receive software tutorials and instruction on how to best develop multimedia projects. The instructor makes sure the learners are aware that they will not be receiving credit for completing these tasks, but assures them that the tasks that they complete are tools that will help them be prepared for the coming work that they will engage in. Upon completion of the instruction, the learners are required to work in small groups in the production of the multimedia projects. The rubric for absolute requirements to master the skills and knowledge are posted at the beginning of the project. During the production of the multimedia, learners must share those resources online that they find to be helpful to them during the project production and post their work for review by peers. The instructor is also available for informal critique and feedback. Peers grade each individual's work according to the rubric posted online in the course management tool. The learners that need improvement on their submitted projects then take the peer feedback that they have to improve the project. Afterward, the improved projects are

submitted to their customers for review and critique. The learners repeat the process of improvement based on the customer's feedback. The projects are then submitted to the instructor for further correction and grading. The learners are then offered the opportunity to make corrections for an improvement in the score assessed for the project given. Weekly and upon conclusion of the project, the learners are required to reflect upon these experiences via online journaling in the course management tool.

If we analyze the elements of problem based learning that are present in this project, we will see several. The advanced level of this type of multimedia course requires that the learners have necessary prerequisite knowledge to be able to establish their abilities and functionalities in operating the tools. Moving forward, the context in which the learner's work is quite authentic as they develop a real project for a real customer. Working with a community client requires the learners to probe others for information and receive feedback from not only their customer but also their peers in the development of these projects. Often times the answers may not come from their peers but may also require independent research and study in which the learners seek out alternative sources of information. In the sharing of this knowledge, alternate perspectives are visible and further understanding is witnessed. Finally, the learner's opportunity to reflect and share what was learned in the process provides for the opportunity to attach personal meaning and incentive to continue to work in this environment.

What of the mastery learning? The consistent element of review and corrective feedback is omnipresent in this model. Although the instructor has set forth the standard for which the learners must attain, the corrective feedback and improvement comes from multiple sources e.g. the customers and their peers. Some projects may require little in the way of correction, and others quite a bit. Those that require quite a bit of correction are able to garner the feedback and

apply it necessarily, whereas those that need little; make seek further enrichment from reviewing the peer posted resources and applying deeper applications of which their customers may require. Moreover, in working in collaborative groups, learners may spend time teaching their peers to get them to the level needed. It is also incredibly important to note the fact that learner's awareness and work on the front end of projects. Even though the learners are not receiving credit for the exercises they complete, they realize that they must apply the knowledge in a project-based format. Thus, the incentive to cheat is removed, and the motivation to learn and retain so that the application of the knowledge later is instilled. The last bit that may not be clear right away to the educator is the power of choice in mastering learning of the material. As the instructor assess the "final grade" the learner has the choice to be satisfied with the grade assessed, or to put in the last bit of effort to rise to the occasion for the demonstration of mastery.

Discussion

Clearly some discussion of outcomes related to our singular case are in question, especially from the educator. As many of the other studies have found, there does exist some confusion at first when implementing these types of learning environments. However, once learners are able to become acquainted with the situation implemented, the following has been found:

1. Learners filter and select information for multiple external sources to assist in learning and completing tasks.
2. Learners are dedicated to personal development and feel more accountable for their learning.
3. Learners perform software tasks and functions with fewer queries from instructors and lab assistants.

4. Learner's queries toward instructors focus more on interaction skills and project clarification and less on production.
5. Learners feel motivated to schedule and work ahead.
6. Learners become critical of personal and peers work.
7. Learners become more focused on improving and adding to later revisions.

Much of this may stem from conflicts in the learners mind as they react with information presented to them in the contexts in which they interact (Mayer, 2008). Given that the entirety of the situation is so far from the traditional sage on the stage, the learners are invigorated with energy and motivation. While these findings are not generalizable to a variety of other situations, the examples show promise to the continued application of problem-based learning and mastery learning into multimedia education.

Conclusion

Well-established and popular learning models like problem-based learning demonstrate great hope of possibilities for the education of learners. There exist multiple current cases for the advocacy of embedding such a model in the classroom, especially multimedia education. However, in its entirety, problem based learning cannot solve the issue that requires learners to be masters of the knowledge and skill in the classroom and in the real world workforce. The pessimist may beg to disagree however with the full blown resurrection of any methods involving mastery learning. Those that regard teachers as managers of materials and record keepers of student progress unfortunately seem to indicate an insecure viewpoint of mastery learning. Feedback, correction, enrichment, and instructional alignment are tools that can assist instructors to magnify their power in the classroom (Guskey, 2007). To those that still dread the paper work and record keeping; we must not disregard the overwhelming amount of

technological improvements that can assist in streamlining the process. Moreover, the ability to create efficient, effective, and appealing instruction cannot happen when learning theories are applied as independent tools, separate of other considerations. In further discussion, one also must ask if these two learning models can truly coexist in other classrooms with other learners, especially given the non-generalizable subjects and contexts in place here. That query is one left for the educator to assess in an effort to improve the quality of learning.

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