Developing a Practical Plan for the Implementation of Spaced Practice and Spaced Retrieval with Cognitive Map.

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Introduction

There is a large body of research indicating the effectiveness of spaced practice and spaced retrieval for learning (kerfoot, shaw,etc). However, one element missing is a systematic approach to designing an overall curriculum map to determine the delivery of the right mixture of practice questions, triggering information, articles and other related materials provided at spaced intervals over time.

This paper propose a format for the design and development of such a large scale curriculum and discusses the implementation of such a curriculum as part of a multi-year project to provide instructional content to childcare workers in Maine. This paper describes the theoretical underpinnings and design process used to create the large scale, microlearning format.

To understand the development of the large scale curriculum map for microlearning, it's important to understand how spaced retrieval, retrieval practice and learner mastery fit into the design of the process.

Spaced Retrieval

Web and mobile technologies have allowed small bits of content delivered via technology to be provided to learners using the concept of spaced retrieval. This concept involves providing students with course content spaced over time and has been shown to be an effective tool for aiding student retention (Carpenter & DeLosh, 2005). This is in contrast to mass practice

where a learner attempts to learn a large amount of content all at one time. The methodology used in many professional development settings. The problem with mass practice is that the succeeding and preceding content can interfere with the learning of the new content and fatigue can set in. Spaced retrieval is effective when engaging learners with content over an extended period of time and when reinforcement of the content is important for learning and application. The use of spaced retrieval appears to be growing in popularity with the advent of such computer adaptive instructional models as ALEKS (Doignon & Falmagne, 1985) and LearnSmart (McGraw-Hill, 2013).

The greater the amount of spacing between retrieval events, the greater the potential benefit to retention. Spaced retrieval helps learners retain access to memorized information over long periods of time because the spacing promotes deeper processing of the learned material. Ideally, the time between the learning events is greater than 24 hours, but shorter times have also been found to be effective. As long as eight years after an original training, learners whose practices were spaced showed better retention than those who practiced in a more concentrated time period (Clark & Mayer, 2011).

Within an instructional setting or context, the learner could log onto a website or open a mobile application and be presented with content that they need to learn. The student may earn points for reviewing the content. The next day, the student would log back into the application or website and be presented with a review of the content and new related content. This would continue until all the required content was covered.

B8. Retrieval Practice

Retrieval practice requires learners to recall information rather than simply reread or re-listen to it. Retrieval practice primarily uses tests or quiz questions as a means of requiring

students to recall previously learned information. As an example, the learner is provided with a quiz question, asked to answer it, and given points, badges, or some other type of reward for correctly doing so. This is primarily used where students' learning is measured through performance on quiz questions and they are rewarded as the content is correctly recalled and eventually mastered. This process does involve repeating missed questions until the student gains mastery of all the content. Retrieval practice within the context of seems works best when content is required to be memorized and recalled.

A review of the pertinent scientific literature reveals that the benefits of retrieval practice have been known for at least 100 years and have been demonstrated with many diverse groups (Larsen et al., 2009). Modern computer systems with there ability to record student answers and keep track of performance, allows the learner to engage in the process and answer questions as they are presented in an engaging manner.

Retrieval practice improves student recall performance (Dobson, 2013). Using quizzing as a technique for learning forces the learner to recall content learned previously, and the act of retrieving information from memory actually alters the retrieved memory by strengthening the existing memory trace and/or creating additional retrieval routes. One consequence of these changes is that the probability of successful retrieval in the future is increased, making testing a potent mechanism for enhancing long-term retention (Roediger & Butler, 2013). In essence, the quiz is the game element the student encounters, and answering the questions triggers additional game elements like points or badges.

As an example of this technique, is when a learner receives a quiz question on a daily basis and he or she answers the question. If the learner answers incorrectly, he or she is provided with immediate corrective feedback based on the answer. The question is then placed back into

the pool of questions and will be given randomly to the leaner in the future.

Provide Visible Evidence of Progress

In the case of a curriculum unfolding over a long period of time, it's critically important to demonstrate to the leaner, that they are, indeed, making progress toward mastery of the content and skills to be learned. The act of moving through content on the way to a clear end point, such as mastery of a particular terminal objective, motivates learners as does the knowledge they have of how far they have progressed. The design of this type of curriculum should orient the learner to where they are in the instructional process, where they are going, and how much further they have to go until the end. The concept is that the learner is able to "see" progress and receives tangible recognition of their progress. The progress might be in the form of a character moving up a mountain or an image of how close the learner is to the next level (Kapp et al., 2013).

Mastery Learning

Simultaneously the goal and the process of learning with a large-scale curriclum are progression through content. The learner masters an enabling objective on his or her way to eventual mastery of the terminal objective. Underlying this mastery learning approach is a philosophy asserting that under appropriate instructional conditions virtually all learners can master what is taught (Block & Burns, 1976; Bloom, 1971). The basic concept of mastery learning is that instruction is organized into discrete units where it's possible to master the discrete unit before moving to the next unit. The method of moving through the instruction is based on ungraded assignments with formative evaluation as a tool for identifying what is learned and what is yet to be learned and then providing additional support for concepts that have

not been mastered (Bloom, 1971; Melton, 2008).

Mastery learning provides an approach that recognizes that aptitude for learning may be more closely linked to time and perseverance than to ability (Bloom, 1971; Melton, 2008). This is similar to the idea underlying the concept of criterion-referenced tests, which is to assess the performance of each test-taker without regard to the performance of others (Shrock & Coscarelli, 2007). There is no limit to the number of learners who can succeed on a criterion-referenced test, as opposed to a norm-referenced test, which strives for a bell-shaped distribution curve, meaning some students pass and others fail regardless of mastery on the test. The curriclum design process we used for iLookOut uses criteria and levels of mastery to advance the learner from one element of the instruction to the next.

Scaffolding

Scaffolding is a concept built upon the idea of the zone of proximal development, which is the distance between the actual developmental level of the student and the level of potential development of the student (Vygotsky, 1978). Vygotsky (1978) wrote that the distance between the current level of development and the desired level could be closed by having the student engage in problem solving under adult guidance or in collaboration with more capable peers Scaffolding is the application of educational strategies and techniques which help move a learner from his or her current level of knowledge to the next logical level. Scaffolding techniques can include, but are not limited to, hints, checklists, cues, prompting, role-plays, group activities, and even parsing content into small units to aid learning. Another form of scaffolding is illustrated in Merrill's application principle that "instruction should provide coaching, which should be gradually withdrawn to enhance application" (Merrill, 2009, p. 42). In the iLookOut appoarch, the coaching was delivered in one of several forms such as computer generated and mediated

prompts, cues, and hints as well as links to articles and even opportunities to play mini-games. Scaffolding provides support, functions as a learning tool, extends the range of the learner, and permits the accomplishment of tasks not otherwise possible (Vygotsky, 1978).

The use of scaffolding and levels or rewards in the form of achievements provides visual progress to the learner and maintains interest in the instruction as he or she moves from level to level, achieving success as they progress and, eventually, achieve mastery. The levels usually become more challenging as the learner moves toward the end, and the skills they exhibit at the final level would not be developed without the experience of the preceding levels.

Goal Orientation

For the iLookOut project, there were two types of goal orientation: performance orientation and mastery orientation (Blair, 2012). Each of these two types of goal orientation has an impact on how achievements awarded to learners should be constructed. Students who favor a performance orientation are concerned with other people's assessment of their competence. Students who have a mastery orientation are concerned more with improving their proficiency.

To balance student predisposition towards performance orientation, effective learning environments instill a mastery orientation in the goals and feedback they create. Creating a mastery orientation means that learners will more readily accept errors and seek challenging tasks, providing them with the opportunity to develop their competencies. When given mastery goals, learners will have higher self-efficacy and utilize more effective strategies. Students given mastery-oriented goals perform better on complex tasks (Winters & Latham, 1996). To foster mastery orientation, learners should be required to earn achievements that acknowledge effort put forth and support them during challenges. Errors and mistakes should be treated as opportunities to provide diagnostic feedback and encouragement.

Feedback

Feedback and feedback loops are an integral part of learning and adhere to Merrill's (2009) application principle that instruction should provide intrinsic or corrective feedback. A feedback loop is designed to evoke the correct behavior, thoughts, or actions. When receiving feedback in a the learning environment, the learner will receive different levels of feedback (from detailed correction of incorrect action to simple acknowledgement of a correct action), feedback related to the timing of his or her actions, and feedback delivered via different channels (Kapp et al., 2013).