Motivational Matrix for Educational Games

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INTRODUCTION

The study of the motivational factor in educational games (aka EduGames) has been limited up to now. A former study (Karoulis, 2004) discussed some aspects and proposed the adherence to the ARCS model of motivation proposed by Keller (Keller, 1983; Keller, 1998), which describes the motivation of any educational piece according to four factors: attention, relevance, confidence, and satisfaction.

Present study attempts to summarize the attributes of any EduGame, as they are encountered in the relative literature (including representations) and to match every one of those attributes to one (or more) of the ARCS-factors of motivation.

The benefit of this approach is a better understanding of the motivational nature of every attribute of every EduGame and an obvious extension is the evolvement of a set of design guidelines for designers of EduGames and educational software in general.

BACKGROUND

Keller's ARCS Model for Motivation

Motivation is the most overlooked aspect of instructional strategy, and perhaps the most critical element needed for employee-learners. Even the most elegantly designed training program will fail if the students are not motivated to learn. Without a desire to learn on the part of the student, retention is unlikely. Many students in a corporate setting who are forced to complete training programs are motivated only to "pass the test." Designers must strive to create a deeper motivation in learners for them to learn new skills and transfer those skills back into the work environment.

As a first step, instructional designers should not assume they understand the target audience's motivation. To analyze needs, the designer should ask prospective learners questions such as:

- What would the value be to you from this type of program?
- What do you hope to get out of this program?
- What are your interests in this topic?
- What are you most pressing problems?

The answers to these types of questions are likely to provide insight into learner motivation, as well as desirable behavioral outcomes.

Keller synthesized existing research on psychological motivation and created the ARCS model (Keller & Kopp, 1987). ARCS stands for attention, relevance, confidence, and satisfaction. This model is not intended to stand apart as a separate system for instructional design, but can be incorporated within Gagne's events of instruction (Gagne, 1985, 1987; Gagne, Briggs, & Wager, 1992).

- **Attention:** The first and single most important aspect of the ARCS model is gaining and keeping the learner's attention, which coincides with the first step in Gagne's model. Keller's strategies for attention include sensory stimuli (as discussed previously), inquiry arousal (thought provoking questions), and variability (variance in exercises and use of media).
- **Relevance:** Attention and motivation will not be maintained, however, unless the learner believes the training is relevant. Put simply, the training program should answer the critical question, "What's in it for me?" Benefits should be clearly stated. For a sales training program, the benefit might be to help representatives increase their sales and personal commissions. For a safety-training program, the benefit might be to reduce the number of workers getting hurt. For a software-training program, the benefit to users could be to make them more productive or reduce their frustration with an application. A healthcare program might have the benefit that it can teach doctors how to treat certain patients.
- **Confidence:** The confidence aspect of the ARCS model is required so that students feel that they should put a good faith effort into the program. If they think they are incapable of achieving the objectives or that it will take too much time or effort, their motivation will decrease. In technology-based training programs, students should be given estimates of the time required to complete lessons or a measure of their progress through the program.
- **Satisfaction:** Finally, learners must obtain some type of satisfaction or reward from the learning experience. This can be in the form of entertainment or a sense of achievement. A self-assessment game, for example, might end with an animation sequence acknowledging

the player's high score. A passing grade on a post-test might be rewarded with a completion certificate. Other forms of external rewards would include praise from a supervisor, a raise, or a promotion. Ultimately, though, the best way for learners to achieve satisfaction is for them to find their new skills immediately useful and beneficial on their job.

A Classification of Multimedia Representations

The locus of this work is to promote an understanding of the correlation between the four factors of the ARCS model and the characteristics of the employed representations. A well accepted taxonomy is the one by de Jong et al. (2004). However, in order to promote understanding of their employment in EduGames, one has to bear in mind a "virtual" game and rely to one's situated experience. To describe the employment of representations, examples of possible applications are used subsequently. Under this point of view, following categories are of interest in EduGames.

- **Multiple representations:** Text, animation, static image representations, sound, and video constitute the majority of the representations employed in EduGames. Usually, one cognitive aspect is presented by means of more than one representation (e.g., video with sound).
- **Code and modality:** The navigational elements are often icons, still or animated. They (the representing world) depict a navigational structure (the represented world), which is usual in educational environments: next, previous, home, exit, repeat, and help. The rest of the representations occur where interaction with the user is possible. A narration prompts the pupil to act and provides help on it. In such a case, we are talking in both cases of *depictive* and *non-equivalent* representations, which are however *multimodal*, as they employ aural, visual, and tactile modes to interact with the user (the user is often asked to type something). Although, from a usability perspective it could be debatable in how far the used navigation icons are intuitive to a novice user of younger age, the application of such a software often shows that children can easily overcome such burdens with little or not at all help. The exploratory nature of children permits them to explore the interface and discover their capabilities. The "prevent errors" usability factor is important here, in order to hinder fatal errors an exploring user could cause.
- Animation seems to provide potency for *dynamic* and *kinesthetic* (manipulable) types of representations. Often, only *concrete*, *pattern imagery,* and *symbolic elements* are represented. Animation for feedback is considered here to belong to the pattern category, as it only informs the user on the correctness or not of their action. It is obvious that we are dealing here with *depictive feedback* (if it is correct or not) and not with *constructive feedback* (in what direction one should seek for the correct solution).
- Affordances: Rarely do the visual representations provide concrete affordances, in helping to visualize the information. In this sense, they help to structure the cognitive activity and provide patterns for experimentation. However, in most cases animations and sound cues are used as feedback or as a helping facility (explaining narration).
- Concerning the underlying theoretical support, the theories of *dual coding* (Paivio, 1990) and *cognitive load* (Chandler & Sweller, 1991; Yeung, Jin, & Sweller, 1998) seem to be implicitly employed in the design of the majority of the systems. Dual coding theory is de facto implemented in any multimedia environment, and its ultimate purpose is to reduce cognitive load (Mayer, 2003), so it can be argued that the use of multimedia animations intends to benefit from these theories. In contrast, *multimedia design theories* seem to be explicitly employed in the design and construction of many interfaces.
- In regards to the *cognitive modeling* support, it is usually not apparent in the designers' intentions, although most interfaces do not provide any problems on it. Children usually can easily work in the interface, without any hindering. One remark must be stated here, concerning the *redundancy* principle and the claim "avoid presenting verbal information in both textual and narrative form especially when graphics are presented at the same time" (de Jong et al., 2004), and a claim stated by Juul (2000) that "it (the game) must not contain narration; everything must happen in the *now* of the playing."
- At this point, the provided *degrees of freedom* must be discussed. Many gaming environments, which simulate "the school" can not be characterized as a constructivist ones, as most of the exercises employed are already known to the pupils from school and must be performed in a pre-defined way. So, it can be argued that the used representations in such environments significantly reduce the degrees of freedom, while they provide only limited affordances.

These characteristics of the multimedia representations usually employed in EduGames are only a subset of the set of attributes to be considered while designing and constructing an EduGame.