The Motivational Factor in Educational Games

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Abstract. This study proposes a "motivational matrix", which can be applied to match every encountered attribute of educational software in general and educational games in particular in the literature to one (or more) factor of the ARCS model. The study presents this table, illustrates some important aspects as regards the mentioned attributes, states some research questions and proposes directions future research has to take into consideration, in order to elucidate the correct use of this matching by educational designers.

Background

The motivational factor in educational games (aka EduGames) has been limited studied 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 through 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.

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 motivate learners, so that they develop new skills and transfer those skills back to 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 your most pressing problems?

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

John 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; 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.

Matching of motivational and representational characteristics

The locus of this work is to promote an understanding of the corelation between the four factors of the ARCS model and the characteristics of the representations, as described in Karoulis & Demetriadis (2004). To facilitate this matching, this study proposes the employment of a matrix as follows.

The table below presents the four factors of the ARCS model on the top, analyzed in their dominant parameters. On the left-hand column are presented the main attributes of the EduGames, as described in the relative literature (the representations are included)

Table 1: Motivational Matrix of Educational Representations

	Attention		Relevance		Confidence		Satisfaction	
	Curiosity (stimuli variability)	Interest (Inquiry arousal)	Perception of personal needs acom-plishment	Relation to a highly desired goal	Expectancy of final sucess	Sucess under control	Extrinsic rewards	Intrinsic compatibi-lity to anti-cipations
Easy to understand								
Options for creativity								
A challenge (goal)								
Assignments (challenges) in layers								
Fantasy (extrinsic & intrinsic)								
Curiosity (sensory & cognitive)								
Multiple representations								
Code & modality								
Feedback (instant & summative)								
Affordances								
Dimensions								
Cognitive modeling								
Degrees of freedom								
Rewards (into the learning task)								
Abtract material in real world context								

Choices offering								
Competition & cooperation								
Decision making & problem solving								
Learning vs. Game objectives								
Graphics								

Research questions

The initial and central question, according to which every cell of the table has to be filled, is: *"Are the factors of the ARCS model supported by every attribute and how exactly?"*

So, to fill out the table one must consider every attribute on the left-hand column and try to investigate its correlation (if any) to every factor of the ARCS modes, represented by their most dominant parameters. For every matching, a separate investigation must be set up, may it be a case study, a literature review or any other acknowledged approach.

These attributes are collected through an extensive literature overview on the characteristics of EduGames (eg. Azar, 1998; Malone, 1980a, 1980b)

Representations in EduGames have also been considered as attributes and are listed on the table. A valuable source here are the works (among others) of Ainsworth & VanLabeke (2004), van der Meij, J., & de Jong, T. (2004), de Jong et al., (1998).

Another criterion to choose these attributes is their applicability. This is particularly difficult because of the given variety of EduGames. Games encompass many styles and subjects. For example, games may be competitive or cooperative, be played by individuals or groups, and touch on numerous themes, such as adventure, education, social interactions, science fiction, violence, and sexual circumstances. Simulations sometimes are considered games as well. Leemkuil et al. (2000) argue that games as learning environments are closely related to simulations, microworlds, adventures and case studies. The definitions of these environments partially overlap. For instance, the distinction between simulation and games is often blurred, and many recent articles in this area refer to a single "simulation game" entity.

On the other hand, EduGames must underlie some guidelines to be characterized as such. Harlow (2004) classifies them in two categories, process and reward. Process comprises the actual playing of the game, such as the interface, levels, immersion, content and interaction of game mechanics, while reward is either the internal game benefit or external feeling of satisfaction or success the player gains from the process. So, some attributes, such as "challenges", "choices" and "rewards" emerge from this approach.

Further on, a great deal of research focuses on computer literacy and basic programming skills. Playing computer games is a popular recreational activity for young people. Not surprisingly, many of these enthusiasts dream that one day they will develop computer games themselves. So why not use game design as a vehicle to teach youngsters computer science? Developing computer games involves many aspects of computing, including computer graphics, artificial intelligence, human-computer interaction, security, distributed programming, simulation, and software engineering. Game development also brings into play aspects of the liberal arts, the social sciences, and psychology. Creating a state-of-the-art commercial computer game is an incredibly difficult task that typically requires a multimillion-dollar budget and a development team that includes 40 or more people. But simpler alternatives - ones within the reach of students and hobbyists - exist. Budding game developers can have fun creating variations on Pac-Man, Space Invaders, or simple platform games (Overmars, 2004).

Under this point of view, attributes such as “assignments in layers” or “present abstract material in real world context” become also critical and are included in the list.

Another aspect is the social dimension of gaming. Kiefaber (2004) argues that gaming is inherently social and playing games has been closely linked with building relationships and social hierarchies throughout history. Not only games are social activities, but also many times the game itself is secondary to the social experience. Video games are now a permanent fixture to our culture, redefining the process by which children mature and develop. Over the past few years however, a great shift towards Internet-based games has been observed and recorded. The lure of multi-player gaming has been interacting with real people, not artificial intelligence. Live opponents or allies make gaming much more unpredictable and much more enjoyable. Nowadays, not only potential game players are connected to the Internet in large and rapidly growing numbers, but their composition is much more diverse and many new gaming possibilities have been created that were not available with non-Internet games. To conclude, attributes such as “co-operation” or “competition”, “fantasy”, as well as almost all representational characteristics listed in the table above, become also socially important, thus shifting their correct matching to the motivational parameters to an important task.

Emerging needs from this approach for further research and understanding

It is obvious that further research has to elucidate the correct matching (if possible at all) and the matching strategy for every EduGame attribute to every (or more) ARCS factors. The cell will hence describe the details of every particular approach. Research for every case can be in the form of literature review, case studies, experiments or any other acknowledged approach.

However, this implies a huge amount of research, which is not feasible at this time. On the other hand, some research has already been done and some answers are already given. For example, as regards the “graphics” attribute, literature gives an extensive focus on it, as it is stated that „they can capture the students’ interest“ almost in consensus (e.g. Walker, 2003). So, a more realistic approach here would be to focus on some of the attributes which are not yet studied by other researchers and set up some case studies or experiments to clarify their correlation to the ARCS parameters.

In more detail, some EduGames attributes must be chosen and implemented in an EduGame environment. Accordingly, a study, which has clear hypotheses, must investigate whether these attributes have any influence on the augmentation of any of the ARCS parameters, which in its turn would lead to the augmentation of any of the four factors of the ARCS model.

This could be a clear indication that the correct manipulation of the particular attribute can lead to an augmentation of one (or more) motivational factor, leading thus to an enhanced motivation of the EduGame, which is the Holy Grail for every educational designer.

Expected benefits from this approach

Who could benefit from this approach? Educational designers, teachers and any person involved in educational software could benefit from this research. Results are obviously of a broader applicability than only in EduGames, since the motivational factor is usually hardly understood and implemented in educational pieces. So, a reference to some "motivational guidelines" would be of great interest for designers as well as for evaluators of any instructional approach.

Conclusion

The matching of the encountered in the literature attributes as regards educational games with the four factors of the ARCS model proposed by Keller is a daunting task, which however could enlighten many hidden up to now relations between correct instructional design and motivation. Since it is commonly agreed that motivation is the sine qua non of successful learning (Prensky, 2003), it would be a valuable result to explicitly know relations of educational attributes that could enhance any motivational factor.

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