APPLYING THE ARCS-V MODEL TO PLANNING AND DESIGNING AN EDUCATIONAL COMPUTER VIDEO GAME

PRIMJENA ARCS-V MODELA MOTIVACIJE U PLANIRANJU I OBLIKOVANJU EDUKATIVNE RAČUNALNE VIDEO-IGRE

Ivan Blesić, Uroš Nedeljković

Fakultet tehničkih nauka, Novi Sad, Srbija

Abstract

The ARCS-V model of motivation represents the synthesis of volitional and motivational concepts and theories, and serves as a basis for the appropriate motivational design process. This paper starts by introducing the model and the manner of its implementation, with the goal of gaining a predictable increase in the motivational appeal of the instructions to the targeted audience. The paper futher analyzes the existing instructional materials of an educational campaign, isolates its motivational deficiencies, and presents an educational video game as the motivational solution. Various kinds of activities in video games are being discussed, as well as how suitable they are for conveying the contents of the instruction.

Keywords: ARCS-V model, educational campaign, educational video games

Sažetak

ARCS–V model motivacije predstavlja sintezu voljno–motivacijskih koncepata i teorija te služi kao osnova za prigodni motivacijski dizajn-proces. Rad započinje predstavljanjem modela i objašnjenjem njegove implementacije s ciljem postizanja predvidivog porasta motivacijskog apela instrukcija ciljanoj publici. U nastavku je izvršena analiza postojećeg sadržaja instrukcije edukativne kampanje, izdvojene su njezine motivacijske deficijencije te je, kao motivacijsko rješenje, razvijena edukativna računalna video-igra. Raspravlja se o vrstama aktivnosti u video-igrama i o pogodnosti istih za prenošenje sadržaja instrukcije.

Ključne riječi: ARCS-V model motivacije, edukativna kampanja, edukativna video-igra

1. INTRODUCTION
1. *UVOD*

Back in the '80s, a wealth of hypothesis and concepts regarding motivation and instructional design could be found, only most of them contained overlaping or conflicting elements. For the purposes of ameliorating this, John M. Keller, along with several of his students, has made an extensive revision of the theories and produced a synthesis of four categories of motivational variables originaly titled Interest, Relevance, Expectations and Outcome. Over time, this model became focused on application and so the names were changed to Attention, Relevance, Confidence and Satisfaction, respectively. These names form the acronym ARCS.

However, practical application of the traditional ARCS model has proven insufficient to fully elaborate the differences between student persistence. In order to articulate these differences, Keller added a fifth category, Volition. Keller sometimes compared it to self-regulation, for simplicity [1].

The ARCS-V model in its essence isn't developed as a behavioral change model. Instead, the ARCS-V motivational model helps the instructor recognize the component (or components) in his instruction which diminishes or over-stimulates the motivation of the recipient, as well as provides the instructor with the motivational strategies to use in order to adapt the instruction to the motivational needs and interest of the recipient.

1.1. The categories of the ARCS-V motivational model

1.1. *Sastavnice ARCS-V modela*

The first component of the ARCS-V motivational model represents the basic element of motivation and a requirement for any form of study. In pratical terms, it deals with guiding and maintaining the attention of the recipient.

The Attention of a recipient is ensured via engaging his or her curiosity. It is in the nature of every recipient to enquire of that which has been perceived, and this helps visualize the link between themes in the instruction [2]. Examples of this may be a sudden dramatical statement, a sudden loud noise or even an abrupt halt. However, once the Attention is ensured, it has to be maintained in order to keep the level of Attention optimal (not too high, not too low). Something worth noting here is that the optimal level of Attention is the middleground between boredom and indifference versus hyperactivity and feeling anxious [3]. Something similar applies to the Confidence category as well.

Relevance can be viewed as the presented content compared to the content the recipient is inclined to seek out on his own. By providing the individual with some starting conditions and knowledge regarding the given campaign or course, one may emphasize the importance of further seeking informations on the subject matter [2]. Relevance does not only surface from the manner in which a topic is presented, but may emerge from the instructional content itself [3].

The differences in Confidence between the recipients affect his or her dedication or continuance in performing an required action and completing the course. Confidence is achieved when the individual actively links segments of various course themes and perceives his or her own progress [2]. Confident individuals tend to attribute their success to their abilities, rather than plain luck or the task difficulty. On the other hand, individuals with a smaller degree of confidence often exhibit behaviours that demonstrate their ego: they wish to impress others and perceptively fear the undesired outcome [3].

The motivational strategies occuring in this category aim to steadily increase the confidence of the individual while reinforcing how a certain level of success is possible if a certain amount of effort is invested. The key takeaway is to make sure that success is truly attainable. The Confidence category aslo deals with the reduction of anxiety, mostly by providing corective feedback to the individual.

The Satisfaction category researches and practices helping individuals feel proud of their own accomplishments. It is widely considered that the individual will prove more motivated to complete the course if the tasks and rewards are defined in advance, and if, by using a systematical aproach, the instructor reinforces the idea of how the individual is able to achieve success by means of his own planned effort [3]. When it comes to practiclly designing a process, one must also consider the Volition of the individual. Here, "volition" represents the degree to which

an individual is persistent towards achieving and completing the tasks and demands of the instructional enviroment, and whether the individual completes the cours at all. If Volition proves weak, the Attention of the individual shall stray and it won't be able to devise a solid study plan. On the other hand, if the Volition is too strong, the individual shall have a hard time assessing when and where to cease its efforts. This leads to unnecessary and anxious (over) study, very different from the manner of study that permits the retention of informations [1].

1.2.   Steps in the ARCS-V motivational design process

1.2.   *Koraci u ARCS motivacijskom dizajn-procesu*

Han et al. list ten steps in implementing the ARCS motivational design process, whereas Keller retroactively adds the consideration of the fifth component, Volition [1]. The first two steps involve gathering the course information as well as target audience. These form the foundation for analysing the course deficiencies and sources of these deficiencies, which are evaluated in the fourth and fifth step of the design process. The sixth step is a generative one, where a number of suggestions are made, within each ARCS-V category and their strategies. The seventh step is critical and analytic, and represents the selection of best strategies within each ARCS-V category for the case at hand. These strategies must also best suit the available time, resources and, generally, application scenario of the case at hand. The final three steps consider the intregration between the chosen motivational strategies with the instructional design of the course, developing the course material and an evaluation followed by a possible revision. The tenth step comes after the instructional material has been physically produced and applied, and consists of quantifying the effectiveness of the course material [4].

2. VIDEO GAMES
2. *VIDEO IGRE*

A game is defined as a system where the players involve themselves with an apstract challenge, defined by rules, interactivity and feedback, and which results in an quantifiable outcome often in the form of an emotional response [5]. A similar definition was given by Juul: according to him, a game is a system based on rules, with variable and quantifiable outcomes, where different outcomes are assigned different values, the player invests some effort in order to influence the outcome, and feels connected with the outcome on an emotional level [6].

Jane McGonigal claims how games, regardless of differences in genre and techical complexity, share four defining traits: the goal, rules, a feedback system and voluntary participation [7].

2.1. Types of in-game activities

2.1. *Tipovi aktivnosti u video-igrama*

The activities within a video game may help define it, formulate it or develop it. When developing an educational video game, these activities may augment a specific manner of studying, particularly if the development is tied to a taxonomy such as Bloom's Taxonomy. However, just as is the case with game genres, a multitude of activity combinations are possible, and no single type of activity is exclusive of others. The types of activities that may be found in video games are the following:

- matching
- collecting / capturing
- allocating resources
- strategizing
- building
- puzzle solving
- exploring
- helping
- role playing

2.2. Bloom's Taxonomy

2.2. *Bloomova taksonomija*

When compared to gamification and simulations, the largest number of parameters that need to be examined appear when choosing video games as the medium to transfer the contents of an instruction. Namely, the activities within a video game are matched with an instructional taxonomy in order to ensure learning occurs. For this purpose, Bloom's Taxonomy is used most. According to Bloom's Taxonomy, the types of learning can be classified into three domains:

• cognitive – thinking, understanding and the synthesis of knowledge

• affective – the emotional domain, used in instructional design in such cases where the instructor desires to try to influence the student's attitude

• psychomotor – the intersection of physical skills and cognitive knowledge

The affective domain categories can also be linked with in-game activities [5]. Table 1. lists these categories, their definitions and sample game activities:

Table 1. *The link between the affective domain categories of Blooms's Taxonomy with the types of in-game activities*

Tablica 1. *Veza Bloomove taksonomije afektivne domene s aktivnostima u igrama*

Category	Definition	Sample Game Activities
Internalizing Values	Integrating into the person's behavioral pattern	Strategizing, Helping
Organizing	Determination that a value or behaviour is important or a priority	Role Playing, Helping
Valuing	Willing to express a positive attitude toward a value	Role Playing, Helping
Responding	Willing to participate at a basic level. May not be permanent	Matching, Collecting, Helping
Receiving	Willingness to pay attention and notice a value or behavior, but remains passive	Exploring, Helping

2.3.   Educational video games
2.3.   *Edukativne video-igre*

Some time ago, educators have argued how the interactive dynamics of games may potentionally be used in teaching and learning. Studies in the past decades have shown an increase in academic interest when it comes to using game mechanics in education. This comes in several forms, from simply embedding game elements into a course, to structuring the entire course as a game.

Bearing this in mind, there are three significant approaches to integrating games into the learining process: to develop educational games with students „from scratch", to develop an educational game on the instructor's own, and, finally, to use comercially available educational games („off the shelf"). In the first approach, the students actively work on the game and in doing so study its instructional content. Whereas at some point this meant teaching the students how to program games, that is no longer the case (consider the CodeWise project, or the Scratch programing enviroment). The second approach puts a lot of pressure on the game author (the instructor), and requres interdisciplinary knowledge and a wide skillset. Still, it is considered the most promising of the three, because it could hypothetically address questions of educational and entertaining value, all within a domain where the instructor is strongest. The third approach is implementing comercially available games (these are often not meant to teach), their customization and use in an educational enviroment. The advantage of such an approach is that the invested resources are low, and the speed of implentation quick. The disadvantage is that these games are not neccessarily meant to teach, meaning the games may feature incomplete and imprecise educational content, and the game themes may not be the best match for the educational content.

3. THE IMPORTANCE OF THE ARCS-V MODEL IN DESIGNING AN EDUCATIONAL GAME FOR A CAMPAIGN
3. *ZNAČAJ ARCS-V MODELA U OBLIKOVANJU VIDEO-IGRE ZA EDUKATIVNU KAMPANJU*

Designing an educational campaign can be seen as a motivational problem. Rather than relying on the use of visuals and appealing messages for the design process, the visual rhetorics is guided towards changing the motivational disposition of the recipient.

The goal of designing the educational campain in such cases surpasses the typical goals of propaganda, attracting attention and informing and must ensure a certain measure of change in the habits of the recipient, those that involve their consious choices, rather than their preferences. Considering this is a long-term goal that should be countinualy reimplemented and whose result is easiest to spot when the campaign concludes, the ARCS-V motivational model has been chosen to guide the design process and research. The application of motivational strategies developed in the ARCS-V motivational design process can then provide a valid reception of the instructional content and a certain volitional action taken by the target audience.

The goal of applying the ARCS-V motivational design process, therefore, becomes identifying the motivational problems and goals (solutions) of the campaign, followed by developing an instructional enviroment (or factors in such an enviroment) tasked with stimulating and maintaining the motivation of the target audience.

3.1.   Applying the ARCS-V motivational design process
3.1.   *Primjena ARCS motivacijskog dizajn-procesa*

According to the ten steps of application mentioned earlier, a number of informations regarding the educational campaign „Čitaj šta piješ" has been gathered, as well as a number of informations regarding the targer audience. This was followed by the analysis of the existing campaign/course material and defining a list of motivational goals. The motivational goals are the following:

1) The cases where the Attention is overstimulated shall be lowered by the tempo of presenting the contents, as well as by giving students the time to reflect on the instructional content. Maintaining Attention shall be handled with a problematical approach, as well as by continually adding congitive dissonances. The targeted audience should recognize this approach in several stages, and the examples must be memorable.

2) By using a different medium to convey the content of the campain instruction, the individuals shall display reduced Confidence towards a content they otherwise might consider trivial. As more of the campaign content is presented, the individuals will realize their existing knowledge doesn't cover the forementioned content, and that a certain amount of effort must be inputed. Furthermore, they will realize how personlized research of relevant data is required.

3) The recipient of the campaing content will establish how the difficulty of mastering the content is proportional to the reward and benefit, and that a system of equality is established. Minimal interventions will be needed considering the Satisfaction category is the least tied to physical mediums of content transferal. The individual shall notice the room for public displays of congratulations and intrinsic Satisfaction.

4) The presentation medium will allow friends to become role-models, increasing the Relevance with those individuals whose Relevance is below optimal. The same may be achieved by quotes prepared beforehand. The target audience shall also recognize behavior led by achievement, as well as analogies withing the game(s) and puzzles.

As for the methods of evaluating success, the use of an adapted IMMS survey is intended. After determining the motivational goals and methods of quantifying success, motivational tactics were generate and evaluated.

The next steps in the ARCS-V motivational design process were its application and the development of the campaign materials i.e. the motivational solution in the form of the educational video game "Zgode i nezgode Malimira". The tenth step is quantifying the efectivity of the video game, for which the IMMS survey is recommended. IMMS is an acronym for Instructional Materials Motivation Survey, and it deals with the reactions of the individual toward the campaign or device content, filled in by the individual himself. This survey is independent from the method of conveying the content [8].

4. AN OVERVIEW OF THE VIDEO GAME „ZGODE I NEZGODE MALIMIRA"

4. *PREGLED RAČUNALNE VIDEO-IGRE „ZGODE I NEZGODE MALIMIRA"*

„Zgode i nezgode Malimira" is an educational computer video game, designed to be a responce to the motivational deficiencies of the educational campaign „Čitaj šta piješ", analyzed through the components of the ARCS-V motivational model and the appropriate motivational design process. The game is of a hybrid genre, a combination of a mission-based real time strategy with a view from an algorhytmically variable camera and a puzzle role-playing game with a view from a following camera.

4.1. Aktivnosti u igri „Zgode i nezgode Malimira"

4.1. *In-game activities in „Zgode i nezgode Malmira"*

Earlier, we examined how certain types of in-game activities were connected with a certain educational outcome. The goal of the video game „Zgode i nezgode Malimira" to influence the attitude of individuals (when it comes to consuming a specific kind of mineral water) was also discussed. This led to the idea of linking the in-game activities with an educational taxonomy, the affective domain of Bloom's Taxonomy, to be precise. In accord with the categories of the affective domain of Bloom's Taxonomy, it is clear how the authors were aiming toward achieving the categories Organizing and Valuing, as well as how Internalizing Values is too unrealistic to expect. The in-game activities which promote Organizing and Valuing are: role-playing and helping, both of which were implemented in the video game.

As far as role-playing goes, the player assumes the role of a paige named Malimir, whose life and circumstances are elaborated although not fully to the player. Malimir belongs to the world of the video game, moves and interacts with the few inhabitants of several towns, helps them with their problems. Those are presented as entangled motives and common interest. Helping mostly bases on enclosing or isolating the harmful effects of chemical elements, or items that may be linked to them (i.e. dragon teath).

Within the towns (locations) of the video game the prevalent activity is Collecting, designed around the need to build a challenge in the game, but this is still in service to Helping. Collecting respondst to the category Responding in the affective domain of Bloom's Taxonomy. Malimir collects resources in the form of units of chemical elements otherwise present in bottles of mineral water (iodine, fluoride, magnesium and calcium).

Figure 1 *A typical screenshot from the video game „Zgodei nezgode Malimira"*

Slika 1 *Tipičan kadar iz video-igre „Zgode i nezgode Malimira"*

For the purposes of developing the video game „Zgode i nezgode Malimira", within the Unity game engine 9 scenes, 4 procedurally generated songs, 13 musical effects, 28 materials, 74 3d models, 2 animatics, 8 particle systems, 22 prefabs, 16 instanciated levels, 55 C# scripts, 5 terrains, 141 textures and sprites, 2 post-effects, 198 blocks of visual scripting commands (containing 2219 words of dialogue) were made or developed. Figure 1 shows a typical screenshot of the video game.

5. CONCLUSION
5. *ZAKLJUČAK*

The video game „Zgode i nezgode Malimira" was developed as the solution to the motivational deficiencies of the educational campaign „Čitaj šta piješ", analysed through the components of the ARCS-V motivational model and the appropriate motivational design process. The modular system of building levels allows retroactive management of the challenge and content, as well as creating different conditions and learning enviroments. Custom modified surveys such as the one accompaning the IMMS method, may be used to quantify the effectiveness of applied motivational strategies. Part of the video game that handles the dialogues may easily be altered for specific purposes.

Usign a computer video game as the medium of transfering the campaign content adds an element of fun to a curicullum which otherwise might be considered „dry" when delivered in a deductic manner. Furthermore, usign computer video games in this manner not only shows potential for use as a teaching and learning device, but also as a means to evaluate specific forms of learning, such as formal and informal learning, previous learning and retention or learning based on experience. Computer video game may play a role in turning a learning enviroment into effective and inspirational places. Despite the fact that the traditional ARCS motivational model was developed before the thriving of the Internet and e-learning, it is interesting to note that numerous studies show how this model still remains a reasonable choice for aiding the design of motivating instructional materials (including the interactive ones).

6. REFERENCES
6. *REFERENCE*

[1] J.M. Keller, "Motivation, Learning and Technology: Applying the ARCS-V Motivational Model", Participatory Educational Research, Vol. 3(2), pp. 1-13, 2016.

[2] J. Marshal, M. Willson, "Motivating e-Learners: Application of the ARCS Model to e-Learning for San Diego Zoo Global's Animal Care Professionals", Journal of Applied Instructional Design, Vol. 3(2), pp. 21-26, 2013.

[3] J.M. Keller, "Development and Use of the ARCS Model of Motivational Design", Performance & Instruction Journal, Vol. 26(9), pp. 1-8, 1987.

[4] K. Han, S. Park, J.M. Keller, K. Park, "Developing a Web-based Tool for Systematic Motivational Design." In: Proceedings of the World Conference on E-Learning in Corporate, Goverment, Healthcare, and Higher Education 2006. Chesapake: AACE

[5] K.M. Kapp, L. Blair, R. Mesch, "The gamification of learning and instruction fieldbook", San Francisco, John Wiley & Sons Inc., 2014.

[6] J. Juul, "Half-Real: Video Games Between Real Rules And Fictional Worlds", Cambridge, The MIT Press, 2005.

[7] J. McGonigal, "Reality is broken", New York, The Penguin Press, 2011.

[8] J.M. Keller, "Motivational Design for Learning and Performance, The ARCS Model Approach", New York, Springer, 2010.

AUTHORS · *AUTORI*

Ivan Blesić
He has earned his bachelors and masters degree at the Faculty of tehnical sciences, University of Novi Sad, Serbia. His primary area of research is game design, followed by motivational and instructional design.

Correspondence
ivan.blesic@uns.ac.rs

Uroš Nedeljković, PhD
He is a lecturer, designer, and researcher, currently employed as associate professor at the Department of Graphic Engineering and Design, at the Faculty of Technical Sciences, University of Novi Sad. He has taught classes in Graphic Design, Visual Communication, Typography, Advertising, History of Type and Typography and History of Graphic Design at undergraduate and graduate level. His field of interest and research projects at The Faculty of Technical Sciences concern the visual–rhetoric potential of graphic communications and advertising effectiveness

Correspondence
urosned@uns.ac.rs