A Scenario of the Formative E-assessment Based on the ARCS Model: What Is the Impact on Student Motivation in Educational Context?

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Abstract—The purpose of this research is to measure the motivation of nursing students, option: multi-skilled nurse (n=58), following their participation in an e-learning activity in the form of formative quizzes. The pedagogical scenario was based on Keller's ARCS motivation model. Data were collected through the IMMS questionnaire adopted from the ARCS model. The results show that the students were motivated by the e-learning activity (mean score = 4.22±, 51091), and that the motivation variables studied correlated positively with the overall motivation score (p-value < .001). Through this research, it was found that an instructional scenario based on the ARCS model had a positive impact on students' motivation for e-learning, thus encouraging allied health educators to design educational tools that can motivate nursing students.

Keywords—motivation, ARCS model, e- quiz, nursing education

1 Introduction

One of the fundamental activities that teachers use when planning courses is defining forms of evaluation, which includes formative assessment [1,2]. Through formative assessment, teachers review learners' understanding and obtain data on learning achieved for formative feedback [3, 4]. In recent years, various studies have prompted changes in the way formative assessment is designed in the classroom to include digital assessment [5, 6, 7]. Moreover, technology-enabled formative assessment has demonstrated its significant pedagogical potential, particularly in terms of performance, commitment, and motivation to learn [8, 9, 10, 11].

Although the literature indicates that the use of digital technology generates levels of student motivation [12,13,14], several questions remain about the nature of the implementation of distance learning materials and regarding how teachers can design tools to interest students in the learning process and maintain their motivation [15,16]. These topics are critical, as motivation remains one of the key factors that determine student learning outcomes [17].

1.1 ARCS model of motivational design (Keller)

There are many theories of motivation for learning, and each theory provides teachers with the basis for building student-accepted teaching tools [18]. One such theory is the ARCS model of John Keller's motivational design theories [19]. This theory presents four steps to promote student motivation in distance learning activities: attention, relevance, confidence and satisfaction.

The bases and principles of the ARCS model [20] can be summarized as follows:

- **Attention**: in this stage, it is necessary to arouse the learners' interest and stimulate their curiosity through a variety of methods when presenting the teaching material to encourage their active participation. This might include activities such as role-playing, quizzes, and other methods. Visual stimuli and humor can also be used to capture attention during training.
- **Relevance:** in this stage, the aim is to design educational content that meets the students' learning needs. The teacher should show them how useful the material is and demonstrate how it will be used to develop their knowledge and skills.
- **Confidence**: in this stage, students must feel able to succeed in their training and understand their chances of success. Thus, learners must be aware of performance requirements and evaluation criteria.
- **Satisfaction**: in this stage, the learner is motivated to learn by appreciating their results. Learning should be made rewarding by providing feedback and reinforcement.

According to this model (figure 1), learners need a balance between all four principles (attention, relevance, confidence, and satisfaction) to promote and maintain their motivation to complete training or e-learning.

The objective of this work is, therefore, to study the motivational reactions of nursing students to a distance formative assessment activity based on the ARCS model, as part of the teaching of a surgical nursing course. More specifically, two research questions were asked:

- What are the motivational responses of nursing students to the online educational material?
- Which aspect(s) of the ARCS model most influence student motivation?

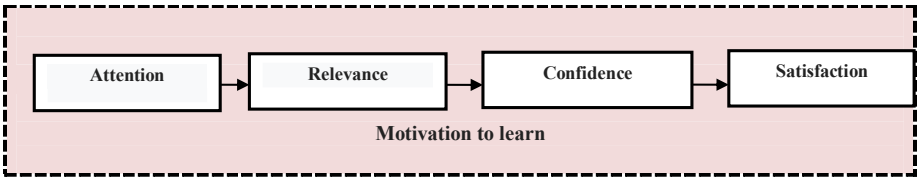

Fig. 1. ARCS Model of Motivational Design (Keller)

2 Material and method

2.1 The adopted pedagogical scenario

The purpose of this study was to evaluate students' motivation after their participation in an e-learning activity. The learning activity used in this study was a series of formative quizzes built on a learning platform. The chosen setting was in a theoretical course entitled "Surgical Nursing." The design of the online quizzes met the principles of the ARCS model of motivation and respected a set of essential points presented in the table 1.

Table 1. Design principles for online quizzes according to the ARCS model

Dimensions of motivation according to IMMS	Principles of design
Attention	• Formative evaluation in the form of quizzes • Student participation in the evaluation process • Involvement and self-assessment • Autocorrection at the end of the quiz • Choice of colors for the presentation • Quizzes illustrated with animations, images, and links • A variety of types of questions to attract attention • A little mood ex: emoticon
Relevance	• Quiz content developed in accordance with the learning objectives for the course being taught • Discussion and sharing of learning objectives with students • Quizzes include an introductory section that presents the nature of the activity and its usefulness in learning • Accompaniment and communication during the online activity (discussion forum) • Feedback towards the end of each quiz in the form of additional information and useful links to complete the knowledge
Confidence	• Quiz designed in a simple and practical form • Choice of questions with tolerable levels of complexity • No trick questions or difficult questions to answer • Feedback provided to give students the confidence to solve the online quizzes
Satisfaction	• Towards the end of each quiz, the student obtains his or her score • Ability to view both incorrect and correct answers • A message is provided to the students according to the score obtained, e.g., Bravo, good work

2.2 The participants

The participants in this study were multi-skilled nursing students in their second year of initial training, enrolled in the professional license cycle (n = 58) at the Higher Institute of Nursing and Health Techniques of Casablanca. In 2020, these students participated in an e-learning activity.

2.3 Measuring instrument

To meet our research objective, we used Keller's IMMS questionnaire [21]. This questionnaire was developed as part of the ARCS model to measure learners' levels of motivation [19] regarding distance learning activities. The questionnaire consists of 36 questions with 5-point Likert scale items, and each group of questions is linked to a factor in the ARCS model. Here is the guide to the IMMS questionnaire (table 2).

Table 2. IMMS scoring guide

Motivation element	Questions
Attention (12 questions)	2, 8, 11, 12 (reverse), 15 (reverse), 17, 20, 22 (reverse), 24, 28, 29 (reverse), 31 (reverse)
Confidence (9 questions)	1.3, (reverse), 4,7, (reverse), 13,19(reverse), 25,34(reverse) ,35
Relevance (9 questions)	6.9.10.16.18.23.26 (reverse), 30,33,
Satisfaction (6 questions)	5, 14, 21, 27, 32,36

2.4 Data analysis

The data collected were analyzed using SPSS version 20 software. The internal consistency of the questionnaire was measured by calculating the Cronbach's α. The results are presented as a mean and standard deviation to assess student motivation levels for each dimension of the questionnaire. A Pearson test was conducted to identify correlations between motivational factors and the overall motivation score. We also determined the correlation between the four factors.

An ANOVA test was carried out to discern whether there were differences in motivation levels between students based on their demographic characteristics.

3 Results

3.1 Internal consistency of the IMMS questionnaire

The internal consistency of the questionnaire was calculated by measuring the Cronbach's Alpha, found equal to 0.93. Therefore, we determined that the questionnaire has a good internal consistency by comparing it with Keller's original questionnaire, which had a Cronbach’s Alpha of 0.96.

Table 3. The internal consistency of the questionnaire

Dimensions Motivation	N of Items	Reliability Estimate (Cronbach) selon Keller (1993)	Cronbach's Alpha in this stydie	Cronbach's Alpha Based on Standardized Items
Attention	(12 item)	0.89	0.76	0.77
Relevance	(9 item)	0.81	0.92	0.91
Confidence	(09 item)	0.90	0.63	0.64
Satisfaction	(7 item)	0.92	0.92	0.92
Global score	**(36 item)**	**0.96**	**0.93**	**0.92**

3.2 Motivation scores/ levels of motivation

According to Table 4, the minimum level of motivation was 3.11 and the maximum level of motivation was 4.92, with an average score of 4.22, which is considered very positive. In addition, the data in Table 5 show that, among the 30 students who responded to the questionnaire, 21 (70%) recorded a high level of motivation (between 4 and 5) as a result of their participation in the online learning activity, and 9 (30%) recorded an average level of motivation (between 3 and 4). This suggests that the students were motivated by the numerical formative assessment.

Table 4. Motivation scores

IMMS Motivation Scores (N=58)					
	Attention	Confidence	Relevance	Satisfaction	Motivation (Total score= 36 items)
N Valid	58	58	58	58	58
Mean	**4,4833**	**3,9333**	**4,0778**	**4,3667**	**4,2250**
Std. Deviation	,41257	,52975	,81239	,78100	,51091
Minimum	3,50	2,89	2,00	2,33	**3,11**
Maximum	5,00	4,89	5,00	5,00	**4,92**

Table 5. Classification of motivation levels according to the ARCS model

Motivation levels (N= 58)			
Score Ranges	Motivation category	Frequency N = 30	Percentage
144-180	High motivation	N= 40	70%
109-143	Average motivation	N=18	30%
72-108	Low motivation	N=00	00%
< 72	Very low motivation	N=00	00%

According to the ARC model of motivation, attention is the first element that students must have during a learning activity involving technology. In this research, the "Attention" variable had a average score of 4.48 with a minimum score of 4.20 (items 2 and 7) and a maximum score of 4.73 (item 8), showing that the Online Quizzes were positively engaging for the students and were catchy rather than boring.

The 2nd element of the model is the relevance of the tool and the exercises proposed. The average score obtained was 3.93, with a minimum score of 3.8 (item 21) and a maximum score of 4.27 (item 14). This means that students believed the online quizzes to be relevant. In the Confidence variable, the average score obtained was 3.93 (minimum score = 3.8 and a maximum score = 4.27) showing that the quizzes were not difficult, which gave the students confidence that they could solve them.

In the last element of the model, satisfaction occupies an important place. In our study, the students were satisfied with the Online Quizzes and would like them to be included in other courses (average score = 4.36; minimum score = 4.27; maximum score= 4.53).

Table 6. Motivation levels by item/variable

Items of IMMS	N	Mean	Std. Deviation
Attention			
There was something very interesting in the wording of the quizzes that caught my attention	58	4,27	1,048
Online quizzes are really eye-catching	58	4,20	1,031
The quality of the design of the quizzes caught my attention	58	4,23	,935
The quizzes were very incomprehensible so I couldn't follow them	58	4,73	,521
The quiz design was uninteresting and unattractive	58	4,37	,964
The way the quizzes were written caught my attention	58	4,53	,629
There were things in the quizzes that stimulated my curiosity	58	4,20	,961
Sometimes I was bored with repetition	58	4,73	,450
I've learned some surprising and unexpected things	58	4,63	,490
The variety of feedback, comments, and links helped me to get interested in the quizzes	58	4,57	,679
The quiz writing style was boring	58	4,67	,802
There were several words in the quizzes that were really irritating	58	4,67	,547
Confidence			
When I first looked at the online quizzes, I had the impression that it would be easy for me	58	3,83	1,053
The online quizzes were very difficult to solve that I thought	58	4,27	,785
After reading the introductory information, I knew what I was going to learn from the quizzes	58	3,97	,890
It was difficult to choose or remember important points because there was a lot of information in the exercises	58	3,90	1,062
When I started the quizzes, I was confident that I would be able to solve them	58	3,73	1,230

Relevance			
It was clear to me that the content of the quizzes was related to what I already know	30	3,83	1,053
There were information, illustrations, and examples to show that these quizzes can be important to students	30	4,10	1,062
Solving the quizzes was really important to me	30	4,07	1,081
The content of the quizzes was relevant to my learning interests	30	3,97	1,159
There were explanations and examples of how people use their knowledge in these exercises	30	3,80	1,031
The design and writing style of the quizzes gave the impression that they deserve to be solved	30	4,10	,960
The quizzes were not relevant to my needs because I already knew the answers	30	4,47	,730
I could relate the content of the quizzes to what I saw in the course being taught	30	4,10	1,155
The content of the quizzes was useful for my learning	30	4,27	,980
Satisfaction			
Completing the quizzes gave me satisfaction and a sense of accomplishment	30	4,27	,828
I really liked the online quizzes and I wanted to do them in the other courses	30	4,53	,860
I had the pleasure of learning with the quizzes in the course	30	4,43	,817
Feedback or comments after the exercises gave me rewards for my efforts	30	4,17	1,053
It was good to pass these quizzes	30	4,47	,973
It was a great pleasure to work on well-organized exercises	30	4,33	,959

3.3 Correlation between motivation and ARCS variables

To determine which of the four factors in the ARCS model (attention, confidence, relevance, and satisfaction) most influenced nursing students' motivation towards the

online educational activity, we analyzed the data with a Pearson's correlation test, which revealed a correlation between the four factors and motivation (p-value < .001).

To assess whether there were differences in motivation levels among participants based on their characteristics (age, gender, baccalaureate track, and previous year's grade), an ANOVA test was performed. The results of this test did not signify a significant difference between all factors.

In addition to the data presented, an examination of the correlation between the four motivation variables indicated that they correlate with each other quite significantly (p-value < .001).

Table 7. Correlation between motivation and ARCS variables

Correlation Between Motivation and ARCS Variables			***Motivation***
Pearson 's Correlation	***Attention***	Correlation Coefficient	,735**
		Sig. (2-tailed)	**,000**
		N	58
	Confidance	Correlation Coefficient	,842**
		Sig. (2-tailed)	**,000**
		N	58
	Relevance	Correlation Coefficient	,915**
		Sig. (2-tailed)	**,000**
		N	58
	Satisfaction	Correlation Coefficient	,739**
		Sig. (2-tailed)	,000
		N	58

*. Correlation is significant at the 0.05 level (2-tailed).
**. Correlation is significant at the 0.01 level (2-tailed).
** p value < .001

Table 8. Correlation within ARCS conditions

			Attention	Confidance	Relevance	Satisfaction
Pearson's rho	Attention	Correlation Coefficient	1,000	,429*	,588**	,368*
		Sig. (2-tailed)	.	,018	,001	,045
		N	58	58	58	58
	Confidance	Correlation Coefficient	,429*	1,000	,762**	,580**
		Sig. (2-tailed)	,018	.	,000	,001
		N	58	58	58	58
	Relevance	Correlation Coefficient	,588**	,762**	1,000	,723**
		Sig. (2-tailed)	,001	,000	.	,000
		N	58	58	58	58
	Satisfaction	Correlation Coefficient	,368*	,580**	,723**	1,000
		Sig. (2-tailed)	,045	,001	,000	.
		N	58	58	58	58

*. Correlation is significant at the 0.05 level (2-tailed).

**. Correlation is significant at the 0.01 level (2-tailed).

4 Discussion

Measuring motivation is essential to evaluate the effectiveness of an instructional scenario. The goal of this research was to study nursing students' motivation towards an online learning activity (formative quizzes) based on the ARCS model of motivation. According to the model, the scores obtained through the distributed questionnaire demonstrate positive motivation following the students' participation in a distance learning activity. The average motivation score was 4.22 and 70% of the participants recorded high motivation (between 4 and 5). All the variables studied correlated positively with the total motivation score.

Our results corroborate those of other similar studies; particularly research conducted using the ARCS model of motivation. For example, David et al. (2009) [22] reported that pedagogical changes based on the ARCS model can enhance motivation and improve learning and that trainers can apply the model effectively. Similarly, another study conducted by Huang (2016) [23] to measure participant motivation in the mass implementation of open online courses (MOOCs) using the IMMS questionnaire found that the motivation level of most participants was positive and that they were satisfied with the pedagogical materials provided in the MOOCs. However, learners also anticipated improvements in some areas.

More recently, Kimberly (2019) [24] concluded that learning and assessment strategies based on the ARCS model can be effectively used to improve and maintain participant motivation in a pharmacy elective.

In summary, other studies in the literature have highlighted the value of applying the ARCS model based on the four dimensions of motivation (attention, confidence, relevance, and satisfaction) in the design and development of educational tools. This provides a method for teachers, particularly in the nursing sciences, to adopt effective teaching and learning strategies regarding engagement and motivation.

5 Conclusion

Based on the data from this study, although conducted with a small sample (N=58), a pedagogical scenario based on the ARCS model can stimulate students' motivation to follow an e-learning activity.

In fact, the overall results showed a satisfactory motivation score of n = 4.22, and the students enjoyed this learning activity enough to want to repeat it in other courses. This finding provides nursing educators with avenues for developing educational materials that motivate learning and breaks with traditional models of formative evaluation that have historically been practiced in paper-and-pencil format.

6 Ethical considerations

Prior to the administration of this study, ethical aspects were taken into consideration. These include the agreement obtained from the Moroccan Ministry of Health to carry out this study, which is part of the preparation of a nursing sciences thesis. It should also be noted that participation in this study was voluntary, and the informed consent of students was obtained after an explanation of the purpose of the study.

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