Pedagogical mediation using the virtual learning environment and the new generation: A search for improved performance in medical education

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Abstract

Introduction: Medical schools face increasing challenges to accommodate new health care needs. However, little has changed regarding the students' education. In addition, educators face the challenge of improving their teaching approach, making it suitable and effective for the new generation. The purpose of this work was to describe and contextualize the application of active pedagogical methodologies using the virtual learning environment (VLE) as a tool to improve the students' performance.

Methods: This research is a quantitative and qualitative case study, carried out in one faculty of medicine in the state of Amazonas. Given a total population of senior students in this faculty, the number of participants corresponds to a proportion of 75% in the period of two years. This work required a paradigm shift, by focusing on interactive and technological teaching, professionalism, mentoring, communication, and feedback. Courses using virtual learning environment (VLE) should be prone to interaction, dialogue, collaboration and, asynchronously, autonomy. One of the key aspects of VLE content production is to select appropriate subject matters and texts to be discussed. It is through the VLE contents that the mediation of knowledge construction process and the participants' interaction takes place.

Results: The improvement over the pre-test evaluation was evident, ranging between 12.59 and 50.9%, depending on the subject matter, to 81.31% in the final evaluation. In addition, the students expressed consistently positive opinions regarding the use of VLE.

Conclusion: The use of VLE as a pedagogical tool, in an interactive format and appropriate to the transmission of information and knowledge construction, was adequate for an evident improvement in the cognitive performance of the senior students of medicine. In addition, the positive evaluation of the students regarding the pedagogical methodology used constitutes an added value of this approach.

Keywords: Teaching, Education, Medical, User-computer interface

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Introduction

Nowadays, medical graduation without residency program is insufficient for good professional practice. In some countries, graduation, as the only requirement for professional practice, is in direct contradiction with this assessment (1). In addition to this pressing problem, educators face the challenge of improving their teaching approach, making it suitable and effective for the new generation. According to Evans et al. (2), medical schools face increasing challenges to accommodate new healthcare needs. However, little has changed regarding the students' education. In most classrooms, conventional in-class lectures do not acknowledge the unique trends of the current generation of medical students. Studies in non-medical schools demonstrate that to be effective, teaching styles must conform to the students' habits, ideas, and preferences. The new generation is comfortable with technology and multitasking. Students of this generation learn quickly from their mistakes and are generally attentive if the class format is in their terms. They appreciate self-directed e-learning as it is convenient and efficient, allowing control over rhythm, sequence, and content.

Therefore, to achieve results, medical educators need to understand the differences between generations. This requires a paradigm shift, by focusing on interactive and technological teaching, professionalism, mentoring, communication, and feedback. The identified learning obstacles include authoritarian teaching, large classrooms, no interactive teaching, lack of instructor feedback, and instructors inaccessible by electronic means. This generation has high expectations and does not cope well with additional responsibilities as one should expect in the development of the profession. They were created by parents who told them they were special and natural winners for no other reason than who they are (3). Thus, the unique characteristics of the new generation have to be acknowledged by medical educators (4).

According to Kirkpatrick (5), educational evaluation can be undertaken at four levels. In the first assessment level, there is an attempt to determine student reactions. The second assessment level quantifies the students' learning. In the third level, the assessment is focused on the change in the students' behavior. The fourth assessment level examines the results holistically. The first-level assessment can be achieved through a standardized evaluation instrument, administered after a course for summative assessment purposes. Such an instrument can be composed of a series of Likert-type questions and include comments. In most models of higher education, students evaluate course experience in relation to specific aspects of content, materials, and teaching methods.

The aim of this work was to describe and contextualize the application of active pedagogical methodologies, based on the theories of David Ausubel (meaningful learning) and Reuven Feuerstein (mediated learning experience), using the virtual learning environment (VLE) as a tool to improve the students' performance (6, 7).

Methods

This research is a quantitative and qualitative case study belongs to the exploratory type, designed to provide information for teaching medical students via pedagogical mediation utilizing the VLE. It was carried in one faculty of medicine in the state of Amazonas. The results of the assessments and questionnaire are presented in a narrative synthesis. Data of the different assessments and pedagogical methods were triangulated to perform a comparative analysis of the cases (8).

First step - the target public, sampling and ethical aspects

The inclusion criteria consisted of new generation students from the last year of the medical school. The study was conducted during two years, divided into six classes. Given a total population of senior students in this faculty, the number of participants corresponds to a proportion of 75% in the period of two years.

The Amazonas State University Institutional Review Board's approval was obtained for this study and the implied consent was assumed if the survey was completed. The students' participation in specific steps of this work (pre-test, VLE and questionnaire) was voluntary and anonymity was preserved.

Second step – the choice of themes

Considering the complexity and adequacy, we chose the themes in relation to the relevance of contents and over students' feeling that it is possible to use their learning in real-life applications; for example, the restriction of intrauterine growth was considered to be the most important learning content and consequently the most time-consuming one. Due to prenatal failure, the lack of its diagnosis is among the main contributing factors for poor obstetric outcome. In addition, it provides the opportunity to approach important pathologies, such as the specific hypertensive disease of gestation and its prophylaxis.

Third step - prognostic assessment (pre-test)

To evaluate the results of the pedagogical methodology, there were evaluations carried out prior to the formations (pre-test) to obtain the baseline of the students' knowledge. This prognostic assessment aimed to diagnose, that is to inventory the knowledge of a student and take stock of the situation. Its purpose was clearly to guide. The pre-test consisted of basic questions that prioritized the "*perte d'une chance*" (loss of a chance) in medical care during prenatal care and the medical knowledge update in obstetrics and gynecology of past erroneous paradigms that led to bad clinical practice. These erroneous paradigms were broken by recent medical evidence.

Fourth step - pedagogical mediation

To achieve effective pedagogical results, pedagogical mediation was used, privileging communication and dialogue towards student emancipation. Contents were presented in a dialogical and contextualized way, thus favoring a meaningful learning. The VLE content was organized accordingly. The learning activities were supervised, and provided with online support and electronic communication throughout the learning process. The students were encouraged to share their experiences, through dialogue and interaction for the construction of knowledge. These objectives were achieved by using synchronous communication tools through chat and video conferencing.

Active teaching activities were developed

through the VLE (Figure 1). The topic was discussed in three VLE sessions within one week. The first session was held with a dialogic teaching. In the second period, the oriented reading of two articles was carried out asynchronously, in addition to clinical case-based learning. The third session was conducted synchronously, by analyzing clinical case study through interactive group discussions in chats with immediate feedback in the forum (9-11). The third session was done with the class divided to ease the interaction and the immediate individual feedback by the teacher. The VLE platforms used were Chamilo and custom Drupal. The main tool used was *learning path (The learning path tool in Chamilo allows the professor to build a sequence for the lesson, creating conditional activities and resources. It " forces" the students to follow a certain sequence).* This organizational tool allows generating learning paths to help guide the students through a specific sequence of learning objects and experiences.

Regardless of VLE activities, the students had access to simulation-based learning and actual medical practice. During the educational activities, there were assessments with feedback and debriefing to achieve the learning goals (12).

Fifth step - comparison between pre-test and final evaluation

A summative assessment was carried out in the time of the final internship evaluation for approval purposes and for the continuous improvement of the pedagogical activity. It measured the learning
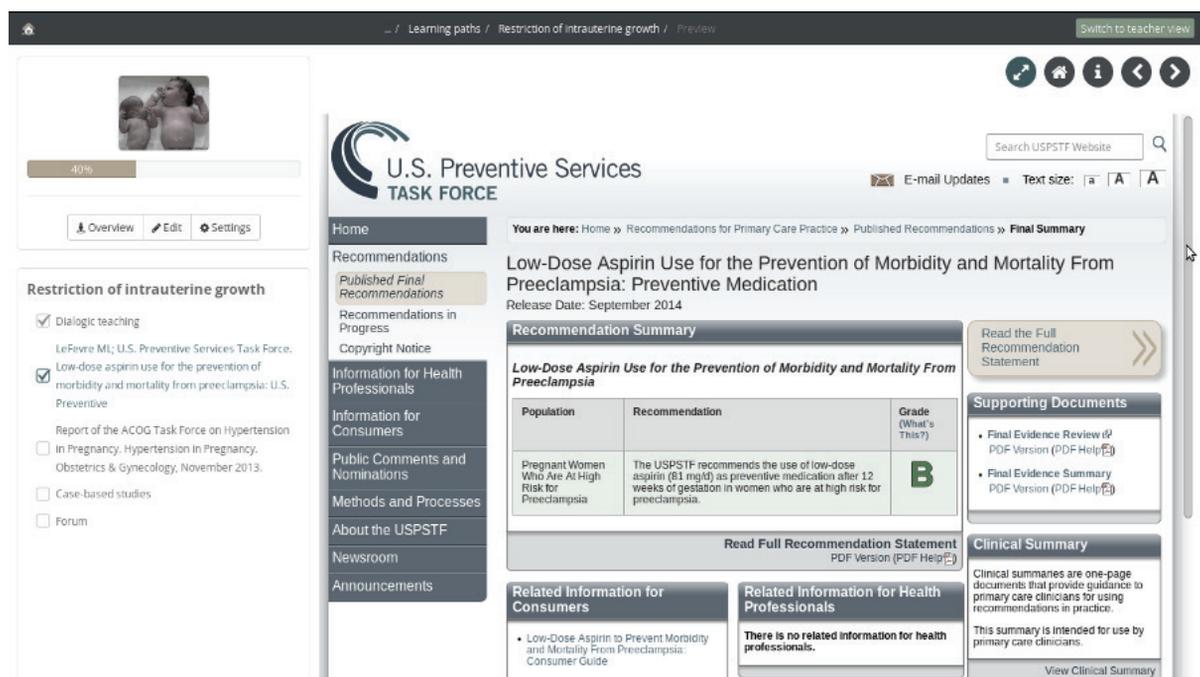
Figure 1: Learning path tool in chamilo

Table 1: The initial student evaluation (pre-test)

Subject matter	Correct answers	Incorrect answers
TORCH*, menopause and cervical cancer	12.59%	87.41%
Susceptibility interpretation (IgG e IgM)	50.9%	49.1%
Primary infection interpretation (IgG e IgM)	49.1%	50.9%

Basic questions (n=110 students)
*TORCH Infections: Toxoplasmosis, Other (syphilis, varicella-zoster, parvovirus B19), Rubella, Cytomegalovirus, and Herpes infections

Table 2: Final grades of VLE questions (n=121 students)

Subject matter	Correct answers	Incorrect answers	Not applicable
Lues	79	42	
TORCH complex	106	15	
Infectious diseases during pregnancy	83	38	
Cervical cancer screening	97	24	
Cervical cancer nomenclature and histological classification	88	33	
Hormonal replacement therapy during menopause	84	37	
Prophylaxis and treatment of osteoporosis	113	8	
Physiology of menopause	103	18	
Vulvovaginitis due to bacterial vaginosis and candidiasis	70	2	49
Fetal vitality	59	13	49
Intrauterine growth restriction	67	5	49

outcomes and provided information for a future program revision. This final evaluation contained questions on the themes addressed in pedagogical mediation and traditional learning method.

Sixth step - evaluation of the course by the students (after the course)

Evaluation of the course by the students was carried out after the final evaluation of the internship stage, using an adapted questionnaire. EAD-specific course evaluation questionnaires refer to three types of research forms known as ATTLS (Attitude towards Thinking and Learning Survey), COLLES (Constructivist On-Line Learning Environment Survey), and Critical Incidents. In these questionnaires, there are no right or wrong answers, they focus in the student's opinion, and there is no impact on the participant's evaluation. The adapted questionnaire sought to assess the adequacy of the pedagogical methodology used for the proposed

objectives, the relevance and importance for their future professional life, and the teacher's performance. The Likert attitudes scale was used for scoring.

Results

The initial student evaluation (pre-test) revealed the low level of prior knowledge of the basic and essential contents taught using conventional techniques during graduation (Table 1). 110 out of a total of 121 students (90.90%) participated in the pre-test.

The final student evaluation on VLE questions, in final internship evaluation, is shown in Table 2. The pre-test and the VLE evaluation cover the same subject matters.

A direct comparison of VLE-based learning with traditional learning is not possible since the contents are not the same. In addition, the time spent on studying was different. Studying over the same contents was more time-consuming in

Table 3: Comparison of the students' grades (n=121 students)

Classes	Final grades average	VLE average	Non-VLE average
Class 1 (n=13)	61.95%	81.11%	57.16%
Class 2 (n=12)	67.27%	74.24%	58.84%
Class 3 (n=20)	50.37%	73.35%	46.83%
Class 4 (n=26)	52.29%	79.37%	47.87%
Class 5 (n=25)	63.34%	86.9%	57.36%
Class 6 (n=25)	57.32%	87.63%	51.66%
Classes 1 to 6 (weighted average)	57.81%	81.31%	52.52%

VLE topics vs. non-VLE (traditional learning method) topics

Table 4: Evaluation and student satisfaction ("n"=102 students)

Questions	Answers		Questions	Answers	
1. Was motivation (stimulus, orientation and induction of goal-directed behavior) provided by the teaching methodology used adequate for understanding?	Every time	55	9. Were goals achieved?	Yes	97
	Most times	44		Partially	5
	Sometimes	3		No	0
	Never	0			
2. Have the main ideas been revisited, clarified, or completed when necessary?	Every time	78	10. Was the teaching material relevant to improve content learning?	Yes	96
	Most times	22		Partially	6
	Sometimes	2		No	0
	Never	0			
3. Were the examples illustrative, relevant and adjusted to the proposed subject matters?	Every time	79	11. Were the visual aids used properly?	Yes	92
	Most times	22		Partially	10
	Sometimes	1		No	0
	Never	0			
4. Has the teacher demonstrated an adequate domain of the subject matters covered?	Every time	96	12. Has the content changed paradigms (representing a pattern to be followed) for a good medical practice?	Yes	97
	Most times	6		Partially	4
	Sometimes	0		No	1
	Never	0			
5. Was there a sequence in themes development to improve students learning?	Every time	69	13. Was learning important for a future professional life if you practice family medicine or specialty or related?	Yes	96
	Most times	29		Partially	4
	Sometimes	4		No	0
	Never	0		Not applicable (specialty or related)	2
6. How deep were the subject matters developed?	Optimal	73	14. Has the content brought new relevant knowledge to good medical practice?	Many	93
	Very Good	25		Some	9
	Good	4		None	0
	Bad	0			
7. Were the teaching techniques adequate to the proposed objectives?	Every time	55	15. Was the content adequate for the purpose of general practitioner training?	Yes	94
	Most times	40		Partially	7
	Sometimes	7		No, focused on the training of the gynecology and obstetrical doctor	1
	Never	0			
8. Did the classes meet your expectations?	Exceeded	43	16. The time spent with classes was ...	Enough for content learning, the time being adequate	70
	Corresponded properly	55		Little for learning the content, requiring more hours, therefore the pace could have been slower	8
	Partially corresponded	3		Some with enough time and others with little time for learning	9
	Did not match	1		Exceeded the requirements of the content, wasting time, therefore the pace could have been faster	12
				I cannot evaluate	3

VLE. Thus, an important aspect to consider was that within the VLE environment it was spent (approximately) thrice the time spent using a traditional approach. However, since there is equivalence between the question levels posed to both questions groups in the final evaluation (VLE-based and traditional learning), there was a strong indication of improvement due to VLE. Therefore, a conclusion regarding performance improvement, based solely on VLE Vs traditional learning method, becomes difficult (Table 3).

The use of a VLE with subject matters normally taught using conventional techniques allowed an improvement in the students' cognitive performance. The improvement over the pre-test evaluation was evident, ranging between 12.59 and 50.9%, depending on the subject matter, to 81.31% in the final evaluation (Table 1 and 3).

To evaluate the student satisfaction regarding active learning utilized in this work, we used a Likert scale ranging from the best-outcome/total-satisfaction to the worst-outcome/total-dissatisfaction (Table 4). A total of 102 out of 121 students participated optionally in the evaluation (84.29%). They answered a 16 question questionnaire at the end of the course. The students expressed consistently positive opinions regarding the use of VLE. The scores of questions 12 to 15 were particularly relevant. An overwhelming majority of the students recognized the importance and potential impact of the materials covered, for their successful performance as medical professionals.

Discussion

Pedagogical mediation can be defined as the teacher-student relationship in the quest for learning as a process of knowledge construction. Such a process is based on the critical analysis of the collective experiences and the work process. The teacher places himself as a facilitator or learning motivator, who actively collaborates towards the learner's goals achievement (13).

The intervention and orientation of the teacher must start from an action that privileges communication and dialogue, towards student emancipation. To this end, the "real development stage", defined as the capacity of a student to take action or to solve a problem by himself, constitutes the starting point. This process would provide the student with mature mental functions, a product of the personal history which reflects the student's confidence on its personal accomplishments (14).

One of the tools for pedagogical mediation is the VLE. Despite being highly associated with distance learning (DL) and used by some authors as a synonym, VLE and DL are distinct concepts. In practice, DL could be achieved without a VLE, per correspondence or per television. On the other hand, the VLE can be used as a tool in the classroom. Conceptually, a VLE consists of a set of electronic tools focused on the teaching-learning process. One of its key components is software running on a server and capable of management and/or supervision of many aspects of the learning process. Such tools can organize the content, track activities, and provide the student with online support and electronic communication (15). In VLE, particularly when used in the DL form, a student's course experience is impacted by the content delivery methods used, as well as by the effectiveness of the teaching strategies designed to promote social interaction in a mediated context. Consequently, although a DL course can be considered equivalent to a performance-based course, VLE can introduce additional situational factors. Among such factors, the lack of familiarity with the interaction method and an asynchronous environment may have a significant influence on the process and results of learning (16).

For the teacher unfamiliar with the world of VLE, the experience may prove to be a complex challenge. Learning how to use VLE platforms and how to master many of its key aspects may require a long time. Moreover, the lack of proper knowledge of its functionalities and pedagogical applications can lead to its misuse and harmful teaching (17). In addition, an adequate virtual learning environment brings differentiation for educational institutions. Therefore, it is important to understand how to use VLE for quality work and, consequently, for effective pedagogical results. The core issue was synthesized by Batista and Gobara, who concluded that VLE usage conceptions were inadequate. The researchers pointed that most teachers used the software only as a repository of activities, not privileging their potential as a space of interactions towards the construction of knowledge (18).

Courses using VLE should be prone to interaction, dialogue, collaboration and, asynchronously, autonomy. As students are seldom the managers of their own learning processes, many find it difficult to adapt to distant learning. This is due to the demands of an autonomous learning process, such as study time management in the absence of tutor supervision. This situation brings the sentiments of frustration and guilt over failure. A way of dealing with the problem is the requirement of experience sharing, dialogue and interaction for the construction of knowledge (18). This objective can be achieved by

using synchronous communication tools through chat or, preferably, video conferencing. It should also be noted that the available information indicates that distance education can significantly reduce the cost of health education at all levels.

One of the key aspects of VLE content production is the selection of appropriate subject matters and texts to be discussed. It is through the VLE contents that the mediation of knowledge construction process and the participants' interaction takes place. Furthermore, for medical training at graduation time, it should be prioritized information that is essential to good medical practice, notably the primary health care. Therefore, there is concern over the relevance of contents and over the students' feeling that it is possible to use their learning in real-life applications. This is fundamental to the success of the discipline; it is the fulfillment of the didactic material's function, which is to assist in the process of teaching and learning. In this respect, the didactic material should be configured as a set of media (printed, audiovisual and computer software), in which the contents are presented in a dialogical and contextualized way, favoring a meaningful learning (6, 18).

According to Cruess et al., the true objective of teaching professionalism is to assist the students in developing their own professional identity. They emphasize that in addition to knowledge and skills, the attitudes expressed in caring, compassion, and integrity are timeless and essential components of the medical identity expected by the society (19).

In addition, medical training requires solid knowledge and basic clinical skills. The acquisition of such proficiency depends on proper learning and, above all, on repeated practice. Communication and interaction, physical examination and diagnostic or therapeutic procedures depend on the tasks involving the participation of people. This is an inclusive definition, composed of actual or voluntary patients, or objects and devices that simulate the clinical situation desired for the type of skill to be learned and trained. The professional practice of excellence is achieved through mastery of a solid theoretical basis; however, it is considered that the acquisition of a solid knowledge base without practice may not induce its mobilization in real life situations (20, 21).

In other words, for the professional dimension, cognition is the basis from which other skills emerge. Miller (20) recognized the fundamental importance of knowledge; that is, that an individual "knows" what is necessary to carry out the tasks of a professional (19). According to Quio et al.,

cognitive theoretical knowledge provides a useful framework for understanding the challenges and successes associated with the training of medical professionals (22). It is widely known that experts are more adept at clinical reasoning than beginners because of accumulated knowledge and experience (21, 22). Thus, it is reasonable to say that medical practical training without adequate cognitive development is inadequate.

In accordance with the curricular objectives, it can be justified to have a greater commitment to cognitive teaching during this period of formation, being practical learning the main objective of the internship. A low cognitive evaluation at the beginning of the internship, according to our data, demonstrates the lack of basic and low complexity knowledge that could cause the "*perte d'une chance*" in medical care. This situation occurs although these subject matters have been assessed in previous years.

The new generation students feel they have more rights and demand better grades as compensation for less effort. In medical teaching, however, good grades without due merit, is not only unfair, but also dangerous (3). As Eckleberry-Hunt and Tucciarone report (4), medical education must adapt to the behavior and values of the new generation. Thus, having a better understanding of the new generation's life experience helps the educators to meet the challenges and frustrations associated with their teaching. The VLE, inserted in the correct context of its pedagogical use, has been shown in our work to be one of the ways to approach the new generation, with positive acceptance and improvement of learning. In other words, it can be empirically concluded that the effectiveness demonstrated by the pedagogical result was due to the adequacy of the teaching styles to the students' habits, ideas, and preferences. In this style of teaching, the students spent more time in the same content without loss of stimulation, enabling in-depth learning on the subject matter. The judgment of subjective passage of time is possibly affected by the hedonic value of the task. Thus, if a task is considered as being pleasant, the students perceive time as passing quickly. On the other hand, when a task is perceived as not interesting, the time is perceived as passing slowly (23). The comments of two students summarize the goal achieved, *verbis*:

"The VLE is a great guide to study, holding the attention in the same content, not noticing the time passing by."

"On the overall evaluation, as well as a great review, the questions were different from what we usually answer; as basic points, they were left

aside, which together make a big difference by increasing the level of complexity of the topic and at the same time expanding the student's horizons. It was in a high level, but adequate to the quality of classes and guidelines throughout this module. The new features were difficult at first contact, but I believe they have achieved the goal. "

However, although better, there is no way to compare VLE results with traditional learning results since the time used for learning as well as subject matters covered differs. Without getting into the discussion of the subject matters that could perhaps be dispensable for a good medical education, it is important to point out that although the active methodology used has been shown to be effective in improving the students' cognitive performance, the time spent for its applicability is incompatible with many curricula of medical courses.

The patient safety problems are also related to medical schools (24). Therefore, mediation by information technology with the initial demonstration of the practical applicability of knowledge, interactivity, knowledge building, learning to learn and feedback can be one of the paths for improved performance.

Conclusions

The use of VLE as a pedagogical tool, in an interactive format and appropriate to the transmission of information and knowledge construction, was adequate for an evident improvement in the cognitive performance of the senior students of medicine. In addition, the positive evaluation of the students regarding the pedagogical methodology used constitutes an added value of this approach.

Conflict of Interest: None declared.

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