Developing a Conceptual Model of Self-Directed Learning in Virtual Environments for Medical Sciences Students

Zohrehsadat Mirmoghtadaie[1], Mohsen Keshavarz[2], Noushin Kohan[3,*] and Soleiman Ahmady[4]
[1]Assistant Professor, Assistant Professor, Department of e-Learning, Virtual School of Medical Education and Management, Shahid Beheshti University of Medical Sciences (SBMU), Tehran, Iran; [2]Department of E-Learning in Medical Sciences, School of Paramedical Sciences, Torbat Heydariyeh University of Medical Sciences, Torbat Heydariyeh, Iran; [3]Department of Medical Education, Smart University of Medical Sciences,Tehran, Iran; *corresponding author; [4]School of Management and Medical Education, Shahid Beheshti University of Medical Sciences, Tehran, Iran

Abstract

Identification of key factors affecting the self-directed learning process in the virtual environment of medical education is vital. In this article, we designed a model that describes the self-directed learning process in the virtual learning environment for post graduate students of medical sciences in Iran. This study was carried out in two steps: first, using a qualitative study, we explored the formation of a self-directed learning process in the virtual environment. Second, a review of the literature was conducted to identify the conceptual models. Finally, based on the results, a self-directed learning model for virtual learning was developed. A total of 25 people were research participants in the qualitative part, and individual interviews were conducted with both faculty members and students. There were 1,049 codes, 80 subcategories, 15 categories, and 5 themes extracted from the interviews and through analysis. The themes included (a) backgrounds and requirements, (b) support, discipline, and coordination of the educational system, (c) students' effort to manage to learn, (d) efficiency, attractiveness, and organization of educational environments and context, and (e) personal excellence, growth, and development. The self-directed learning process in virtual environments consists of some elements and structures, and a description of the relationship between these elements can be the basis of educational planning to develop and compile an effective evaluation of this skill.

Keywords: self-directed learning, virtual learning environment, medical sciences, student

Introduction

In the 21st century, with the ubiquity of technology, entering the virtual world is a very common practice (Garrison, 2011). Online learning refers to teaching and learning processes that are provided through the Internet. It includes a wide range of applications to access educational materials, as well as to facilitate teacher-student interaction (Keshavarz, Mirmoghtadaie, & Nayyeri, 2022). A report by Allen and Seamen in 2013 stated that about 6.7 million students took virtual courses in 2011, denoting an increase of about 570,000 students compared to 2010 (Allen & Seaman, 2013).Virtual education is also very common in the field of health sciences (Kohan et al., 2021). The advantages of such courses include the possibility of independent learning and the availability of resources and information at all times (Ellaway & Masters, 2008; Bagheri-Nesami et al., 2021).

Today, in the digital age, one of the main attributes that learners need to have is the skill to learn in new digital environments. For this reason, teachers must be familiar with digital-age teaching techniques to manage and lead online classes (Kohanet al., 2021; Goldberg & Lannoye-Hall, 2023). However, in line with advances in virtual education in medical sciences, it is necessary to change instructors' teaching methods from traditional models to technology-supported modernized models (Cooket al., 2011; Antonietti et al., 2023). In recent years, e-learning systems have been increasingly influencing both classroom and campus-based teaching, but more primarily, such systems are leading to new models or designs for teaching and learning (Mirmoghtadaie et al., 2023). Attention should be paid to the instructional design of a virtual learning environment distinctively and flexibly based on fundamental learning theories like constructivism and connectivism (Goldie, 2016; Liyanagunawardena & Williams, 2014; Connolly & Wicks, 2023).

E-learning encourages and supports active learning regardless of time and place using certain principles and tools such as web-based communication, participation, knowledge transfer,and multimedia. Therefore, it is considered a key innovation in education (Cummings et al., 2017). With an increase in official and non-official educational opportunities in electronic learning environments, there is much debate over virtual self-directed learning (Goh & Sandars, 2020). Self-direction in virtual learning plays an important role in the success of virtual learners. On the other hand, the flexibility of virtual environments in terms of time, place, and speed of learning increases the possibility that virtual learners accept responsibility for their learning experiences (Rashid & Asghar, 2016; Song & Bonk, 2016; Kara, 2022).

Digitization has transformed opportunities for self-directed learning in informal, non-formal, and formal educational settings. Digital technologies facilitate easy access to information, which facilitates self-directed learning; however, the increasing volume of available information necessitates additional learner skill in information literacy—part of being a competent self-directed learner—in order to navigate information in a meaningful way (Kara, 2022).

The Accreditation Council for Graduate Medical Education (ACGME) considers self-directed learning (SDL) as one of the six key competencies for medical graduates, essential for development and promotion (Education, 2013). In other words, SDL is regarded as a very important strategy in medical education (Shokaret al., 2002; Elshami et al., 2022). The concept of SDL is defined by Knowles as "a process in which individuals take the initiative, with or without the help of others, in diagnosing their learning needs, formulating goals, identifying human and material resources for learning, choosing

and implementing appropriate learning strategies, and evaluating learning outcomes" (Knowles, 1975, p. 18).

Several models have been proposed for understanding SDL in a face-to-face environment. Brockett and Hiemstra (1991) proposed a logical basis for two models in SDL perception. In the first model, learning is viewed as a process in which the learner accepts responsibility for planning, implementing, and evaluating the learning processes. In the second model, SDL was considered to be an objective, and the student must try to achieve that objective. Both the process and the personal attributes of the learner are considered in these models (Brockett & Hiemstra, 2018). According to a model proposed by Garrison, SDL is composed of three dimensions that interact with one another, including self-management, self-monitoring, and motivation. Garrison's model focuses on using resources, learning strategies, and motivation (Garrison, 1997). Song and Hill (2007) proposed a conceptual model for understanding SDL in virtual environments. In this model, the concept of SDL is viewed as a personal attribute of the learner and the learning process. Moreover, a third dimension is context, and it is important to understand environmental factors (i.e.,virtual learning) and their effects on self-direction.

An integrative appraisal of 14 models for self-directed learning has revealed a basic connection between them and suggests an integrated model based on eight characteristics. This integrated model will help researchers by offering a collection of fundamental construct for creating the factors of a theoretical SDL model (Uys, 2021).Face-to-face education was a dominant method in higher education when the majority of the primary SDL models were developing, and limited attention has been paid to developing models addressing SDL in virtual learning environments; therefore, more comprehensive models are required to investigate electronic learning in the process of self-direction. Learning is largely influenced by cultural and social factors. Hence, it is necessary to study SDL in different cultures. Few studies have addressed SDL in Iran. This study was conducted to fill this gap by designing a SDL model for virtual learning environments for postgraduate students of medical sciences in Iran.

Method

This study was carried out in two steps. In the first step, using a qualitative study with a content analysis method, we described the formation of the SDL process in virtual postgraduate students of medical universities and investigated their experiences. Secondly, a review of the literature was conducted to identify and evaluate the conceptual models and frameworks of SDL. Combining the two steps led to the formation of the SDL process model in the virtual environment. The study setting included five top medical sciences universities in Iran. Thepurposeful sampling method was used in the present study. The inclusion criteria for the students and the virtual teachers were, respectively, two terms of passing virtual courses and at least two years of teaching virtual courses. The sampling continued until data saturation was achieved.

Step 1: Qualitative Research

Data Collection Method

The data collection was done through semi-structured interviews after obtaining the participants' informed consent and explaining the research objectives to them. The interviews lasted 35–90 minutes, with an average of 63 minutes, and were immediately transcribed. During the interviews, students were asked questions such as "Would you please tell us your independent learning experience in the virtual environment?", "What activities did you have during the independent learning process in virtual education?", and "What factors were involved in your learning in the virtual environment?" Also, the virtual teachers were asked questions such as "What were your experiences of directing the students during the learning process for them to beself-directed in a virtual environment?" and "What was your understanding of guiding the students during the self-directed learning process?" Some probing questions were also asked to clarify participants' responses. Once 25 participants were interviewed, data saturation was achieved, but four more interviews were done to confirm.

Data Analysis

To analyze the data, the conventional content analysis approach was used,in which the themes and categories were extracted from the content of participants' text data, regardless of previous theoretical approaches. To achieve data immersion, the researchers listened to the interviews several times and transcribed them. This technique helped identify meaning units. The script of each interview was then readline-by-line, and all the words, sentences, and paragraphs, including meaning units, were encoded. The data and codes created were continuously compared. Accordingly, the codes were classified based on similarities. The initial categories were in turn classified and formed more abstract categories.

Ethical Consideration

The research was approved by the Ethics Committee of Tehran University of Medical Sciences (Code: IR.TUMS.MEDICINE.REC.1395.713). The required information, research objectives, data collection methods, confidentiality of participants' information, and ethical considerations were sent to them through e-mails and also explained before the interviews.

Trustworthiness

The four features of credibility, conformability, dependability, and transferability were used to ensure the trustworthiness of the data and findings of our research (Connelly, 2016).The credibility of findings was confirmed using techniques such as member checking and prolonged engagement inthe study (about two years) as well as establishing close relationships with the participants. To increase the conformability of the findings, methods such as peer checking were used. To this end, some of the data and findings were sent to two experienced qualitative researchers and two doctoral students of medical sciences for feedback. The steps of the study were written down to confirm data dependability. Besides, to increase the transferability of the findings, a sampling technique was used with maximum variation in gender, major, and university.

Step 2: Literature Review

The Conceptual Model of Self-Directed Learning Process in Virtual Learning Environments

In this step, SDL models were studied. The relevant models were selected based on the evaluation criteria of Fawcett's models derived from the study by Brathwaite (2003), including comprehensiveness of content, logical congruence, conceptual clarity, abstraction level, and utility (Brathwaite, 2003). Finally, based on the information obtained from the review of related models and the results of qualitative studies, a primary SDL model for virtual learning was developed. To reach aconsensus of experts, the initial draft of the model was presented and discussed through the nominal group technique at the meetings of the expert groups. The proposed model was ultimately approved after receiving the experts' comments and applying the necessary modifications.

Results

The samples included 11 virtual instructors and 14 virtual students, the demographic characteristics of whom are presented in Table 1.

Table 1

Demographic Characteristics of the Participants in Qualitative Research

Characteristic	E-Teachers	Students
Gender		
Male	1	4
Female	10	10
Mean age	48/3 years	37/2 years
Education		
PhD	10	2
MSc	1	12

Note. N = 25.

Qualitative Content Analysis

Students' and instructors' experience of SDL in virtualenvironmentsis a unique experience shaped by educational factors, atmosphere, and culture. This experience is a structure consisting of the elements and phenomena associated with SDL and virtual environments. The primary codes, including 1,222 phrases, were classified into 80 subcategories, 15 categories, and 5 themes. The themes and categories are shown in Table 2.

Table 2

Themes and Categories From Qualitative Research

Number	Theme	Categories
1	Backgrounds and requirements: Prerequisites of self-directed learning in virtual environments (readiness to learn)	Capable and unremitting instructors Ready learners Learning culture and institution atmosphere
2	Support, discipline, and coordination of the educational system (directed toward a goal)	Supportive educational management Purposeful teaching Supporting and guiding the students
3	Students' effort to manage to learn (purposeful effort)	Deep and thoughtful learning Students' excellent performance
4	Efficiency, attractiveness, and organization of educational environments and context (interest in learning environments)	Use of learning strategies Flexible learning environment Pleasant learning environment
5	Personal excellence, growth, development (excellence and progress)	Educational outcomes Cognitive and personality outcomes Social outcomes Emotional outcomes

All subcategories and categories were extracted from participants' views. Table 3 shows the statements of several participants.

Table 3

Themes, Categories, and Statements of Participants Derived From Qualitative Research

Themes	Categories and Statements
Backgrounds and requirements: Prerequisites of self-directed learning in virtual environments (readiness to learn)	Capable and unremitting instructors "I think my role is to design an educational environment for effective student learning, but I also need to have the knowledge and art of how to design an effective environment." (P10) Ready learners "Motivation and attitude also lead to personal pursuit. If I do not know something, I will go and try it myself and learn, and if I see

inappropriate circumstances, I will change it." (P8)

Learning culture and institution atmosphere

"In the educational system, the flow of information is one-way, always from the teacher to the student." (P9)

Support, discipline, and coordination of the educational system (directed toward a goal)	Supportive educational management

"We must teach in such a way that the graduate can find her way in the real environment." (P21)

Purposeful teaching

"We must set a pre-program for it. Make a plan to know what to do and what assignments to do. When and how often." (P17)

Supporting and guiding the students

"The most important element of self-management in cyberspace is interest and motivation, which here if you involve the student in setting goals by the future career process, will indirectly increase student motivation." (P20)

Students' effort to manage to learn (purposeful effort)	Deep and thoughtful learning

"When I entered the virtual environment, my reading habit changed spontaneously. When I entered the virtual environment, I saw that I had to go and print every day and read." (P18)

Students' excellent performance

"My study was using virtual learning facilitators. For example, I became familiar with the concept map on the Internet or used blogs and social media." (P6)

Use of learning strategies

"When I was evaluating myself, if my mistakes were too many twice, I was looking for the reason, and this helped me to learn and study later."

	(P11)
Efficiency, attractiveness, and organization of educational environments and context (interest in learning environments)	Flexible learning environment "Traditional classes with e-learning are very helpful. But the amount should be based on the needs of the student and the type of course." (P13) Pleasant learning environments "The course content has not attractive and we are unmotivated. As a result, we get a PDF file and finally we print it." (P19)
Personal excellence, growth, and development (excellence and progress)	Educational outcomes "If my emphasis is not on the score and I do not have stress, my creativity will increase a hundredfold." (P9) Cognitive and personality outcomes "Last semester we had a class where the students ran the classroom themselves. It was great because we had to search for virtual submissions and our self-confidence was higher than in the past." (P17) Social outcomes "We can also motivate students with homework. When you give the student correct and complete feedback, the student is happy." (P11) Emotional outcomes "One or two semesters later, I was not worried when a project was offered. I felt that with time management I could deliver a good project to the master." (P14)

Note. P = participant.

Conceptual Model

Based on the information obtained from reviewing the models according to the desired criteria and focusing on the findings of the qualitative part, a conceptual model of the SDL process in the virtual environment was proposed. In the conceptual model extracted, it was assumed that students would be influenced by various factors when moving from dependent learners toself-directed learners. This model addresses the elements that influence students' SDL skills in virtual learning environments

based on individual and environmental factors as well asan educational background through a systematic process. The model is shown in Figure 1.

Figure 1

Initial Conceptual Model of the Self-Directed Learning Process in Virtual Environments
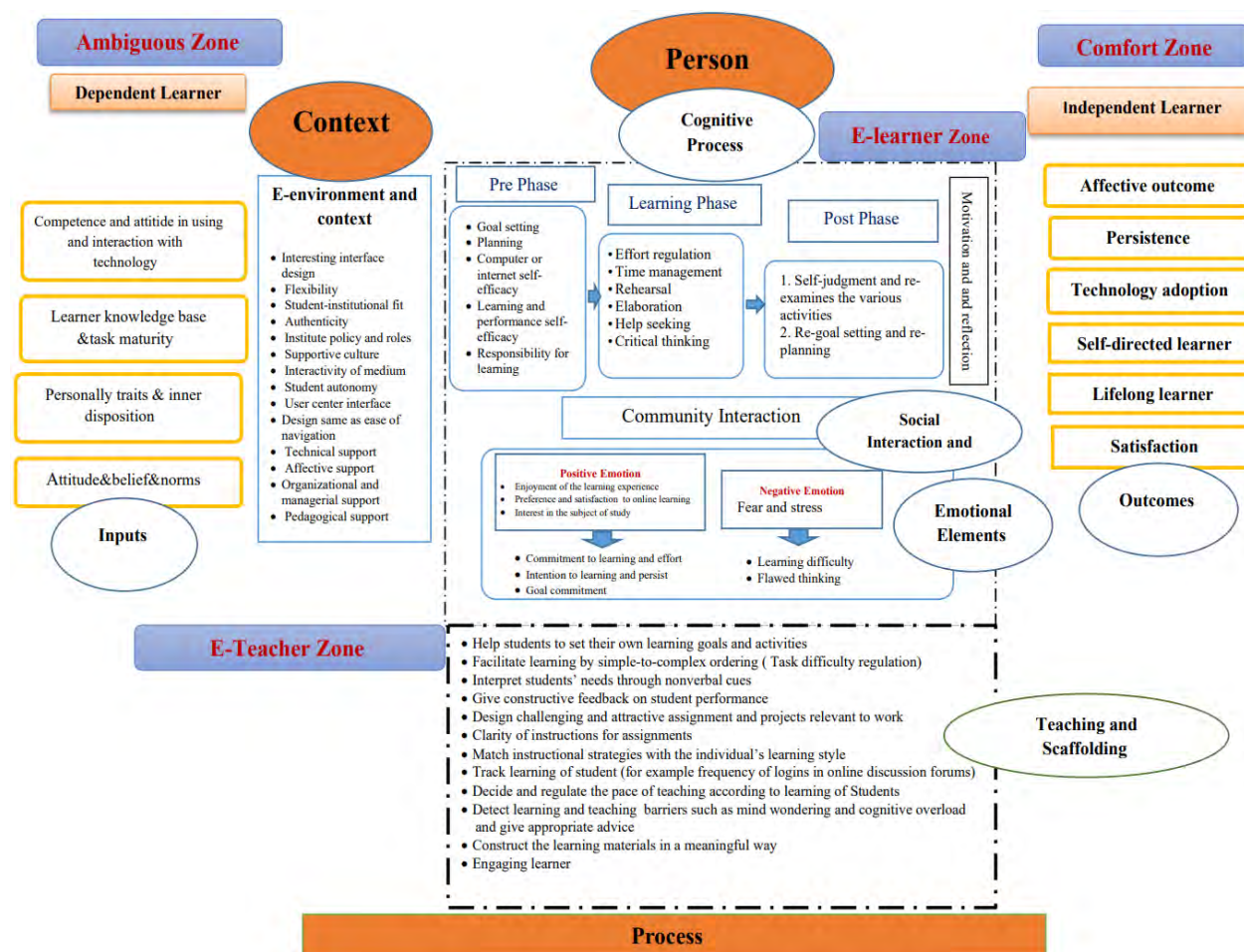
Requirements and Prerequisites

This structure refers to the requirements of educational environments and the individual factors associated with students and provides a background for SDL by students. The requirements include skills, attitudes, and willingness of the students to use and interact with technology and accept virtual learning as effective learning. Some other factors are also influential, such as students' basic knowledge and skills related to learning tasks, as well as their personality traits including self-control, self-management, learning motivation, and lack of feeling isolated in the educational environment.

Educational Context and Environment

An educational context in the virtual environment is provided through e-learning management systems, and self-direction principles should be considered in the design and implementation of such

a context. Controlled access to curriculums, support for virtual learning, and tracking students' activities can be possible through this system. Based on the conceptual model in this research, virtual learning environments should be attractive, flexible, and authentic. Meanwhile, students should be technically, educationally, and emotionally supported. Other factors such as institutional rules and regulations, cultural factors, and backgrounds are also influential.

Intelligent Teaching and Instructional Scaffolding

Directing dependent learning towards SDL is done under the supervision of virtual instructors and through a process called instructional scaffolding. Using digital tools, virtual instructors facilitate the process of active production of knowledge by students. According to the conceptual model in the present study, this structure includes concepts such as helping students to determine the goals and activities of learning, providing the activities and resources in the order of easy to hard, providing constructive and timely feedback to students, designing challenging activities and assignments based onreal scenarios and relevant to the students' future careers, considering learning styles, tracing the students' learning status, deciding on teaching speed, and encouraging student engagement.

Emotional Elements

According to the conceptual model in this research, positive and negative emotions affect the cognitive process of virtual students and their emotional presence in virtual environments. Positive emotions include: enjoying SDL experiences in virtuallearning environments, preferring virtual learning for in-person learning, and interest in the subject, which is often followed by an effort to learn and commitment to achieve the learning objectives. Negative emotions include fear and anxiety, which are mainly caused by factors such as being isolated in the learning environment, lack of time management, and inability to accept various roles and responsibilities in the virtual environment.

Cognitive Process

Based on the conceptual model of this research, students go through pre-learning, learning, and post-learning phases when moving towards self-direction in their cognitive atmosphere. Determining learning objectives and planning for learning happen in the pre-learning phase, and students are expected to have adequate cognitive self-efficacy to use the Internet and computers. During the learning phase, virtual students use strategies such as effort regulation, time management, help-seeking, critical thinking, repetition, and exercises to achieve learning objectives. In the post-learning phase, students will assess and judge themselves ontheir learning performance, and if the learning goalsare not achieved, the students will set the goals again and plan for learning. During this process, rethinking performance and having the motivation to learn is essential and will lead to student maintenance in the process of SDL.

Participation in Learning Communities

Information transfer is not involved in the promotion of SDL skills. On the contrary, negotiation and discussion are mainly emphasized. What matters is the interaction of learners. Such interactions can be synchronous or asynchronous. Virtual students do not only learn from their instructors, but they are also taught through discussing with each other in learning communities (Kohanet al., 2022).

Self-Directed Learning Outcomes

It is expected at the end of each SDL phase that virtual students will achieve outcomes such as being lifelong learners, being self-directed learners, having a sense of satisfaction, adapting to

technologyand the use of the virtual education system, and emotional outcomes such as attachment and eagerness to learn.

Discussion

The results of this study led to a model that depicts the SDL process in virtual environments for medical students. The model was obtained through the qualitative phase data and review of the literature. Although various studies have been done on the design of SDL models in conventional environments and through processes, little attention has been paid to explaining this process in cyberspace. Candy introduced an SDL model in 1991. He had a structuralist approach and believed that personal competencies such as self-management skills were the basis of SDL. Promoting such competencies required continuous effort in the educational environment. He stated that learners showed different levels of self-direction in different learning situations (Candy,1991). In his model, as in the proposed model in this research, personal competencies were referred to as arequirement of self-direction.

Grow (1991) suggested the staged SDL model which focuses on the learning and teaching process. In this model, the instructor guides learners to move from dependence to self-direction through four steps. Each step involves techniques that can be used by the instructor to help learners move to the next step. Grow's model is a typical example of an educational model because it refers to a structure used by instructors who intend to use the self-directed philosophy in teaching.In his opinion, learners go through four stages to achieve self-direction: dependence, interest, involvement, and self-direction (Grow, 1991). Like our model, it focuses on the self-direction process and the factors affecting teaching. However, the two models differ in terms of the type of learning environment.

In Garrison's comprehensive model (1997) previously referred to, knowledge and meaning are formed individually and socially, through a meaningful procedure. The self-monitoring structure in his model is responsibility and commitment to building new knowledge based on prior knowledge. The self-management structure in this model refers to the importance of the learner's control over the learning environment. The other structure of this model is entering motivationand continuous motivation to work on the learning task (Garrison, 1997). It is similar to our model as bothare focused on the student's cognitive presence in the field of learning.

Pilling-Cormick (2002) stated that the three main elements of the SDL process model were as follows: controlling the learning process, the interaction between the student and the instructor, and the factors influencing this control and interaction. To him, the factors influencing a student's control over the learning environment were social constraints, environmental characteristics, and student's and instructor's characteristics. Besides, learning was an active process based on the interaction between a student and aninstructor (Pilling-Cormick, 2002). Both Pilling-Cormick's model and ours take into consideration that SDLis a process and the factors affecting it include the establishment of instructor-to-student interactions and learner's control over the learning process.

Knowles (1980) illustrated SDL as linear and sequential models. But all these models explained that learning was self-directed and that finding learning needs, identifying resources, implementing learning strategies, and evaluating outcomes should be done individually (Briton, 1996). The similarity between their model and ours is that both focus on students' cognitive process in terms of

determining learning objectives, identifying resources and learning strategies, and finally, evaluating learning outcomes.

According to Brockett and Hiemstra (1991), SDL has two different dimensions: a process in which learners take responsibility for all aspects of learning, and learners' personality traits that refer to their tendency to accept this responsibility. The structures considered in their model, named personal responsibility orientation (PRO), included learning context and environment, individuals' ability and tendency to control learning, and personal responsibility for learning (Brockett & Hiemstra, 1991). Their model is similar to ours as both consider the educational setting and personal characteristics for control in SDL.

A conceptual model for understanding SDL in virtual environments was presented by Song and Hill (2007). The model has six main components including input, personal characteristics, autonomy processes, design, support, and outcomes (Song & Hill, 2007). It is similar to our model as they are both process models and take into account requirements such as learners' prior knowledge and their characteristics, as well as cognitive processes and SDL outcomes. In our proposed model, educational settings as well as SDL requirements and other structures of the model are addressed in more detail in virtual environments. Also, structures such as emotional elements and presence in the learning environment are described.

The limitation of the present study was the lack of enough experts in SDL as a specific concept in virtual education.

Conclusion

In this study, by explaining the concept of the SDL process in e-learning, a conceptual framework was developed. The SDL process in virtual environments consists of some elements and structures, and a description of the relationship between these elements can be the basis of educational planning to develop and compile an effective evaluation of this skill.

Limitations

There were some limitations in the present study. One of them, in the qualitative part of the research, is the low sample selection, which suggests caution when generalizing the results. Another limitation was the lack of sufficient expertise in SDL as a concept in the discussion of e-learning. We tried to invite experts who wereknowledgeable about the concept of SDL and virtual education, and had experience of teaching medical students, but we would have liked to have had more participants. It may be worth while to examine the relationship between the concepts in the SDL model in other disciplines. In addition, by designing and implementing interventions based on the model of the SDL process in the virtual environment, the effectiveness of these interventions could be determined. Qualitative grounded theory research should be done to explain the SDL process in virtual education.

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Conflict of Interest

There was no conflict of interest.

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