

Self-Directed Learning Outcomes and Facilitators in Virtual Training of Graduate Students of Medical Education

Masoumeh Safikhani¹, Noushin Kohan², Younes Jahani³, Esmat Nouhi^{4*} 

¹ Master Student of Medical Education, Management and Leadership in Medical Education Research Center, Kerman University of Medical Sciences, Kerman, Iran

² Assistant Professor, Department of Medical Education, Virtual University of Medical Sciences, Tehran, Iran

³ Associate Professor of Biostatistics, Health Modeling Research Center, Faculty of Health, Kerman University of Medical Sciences, Kerman, Iran

⁴ Associate Professor, Nursing Research Center, Kerman University of Medical Sciences, Kerman, Iran

Received: 2020 November 20

Revised: 2021 April 18

Accepted: 2021 April 20

Published online: 2021 October 30

***Corresponding author:**

Department of Medical Surgical Nursing, Razi Faculty of Nursing and Midwifery, Kerman University of Medical Sciences.

E-mail: e_nuhi@kmu.ac.ir

Citation:

Safikhani M, Kohan N, Jahani Y, Nouhi E. Self-Directed Learning Outcomes and Facilitators in Virtual Training of Graduate Students of Medical Education. *Strides Dev Med Educ.* 2021 December; 18(1):e1035. doi:10.22062/sdme.2021.195301.1035

Abstract

Background: Although virtual training has been considered an educational emergency during the coronavirus crisis, it is still discussed in universities as a capacity. Student learning is the concern of all professors. Self-direction is an efficiency indicator in electronic learning (e-learning) widely used in effective educational systems.

Objectives: The present study aimed to determine self-directed learning outcomes and facilitators in virtual course students of medical education.

Methods: The statistical population of this descriptive-analytical cross-sectional study included the graduate of virtual medical education in the universities of medical sciences in Tehran, Iran, in the academic year 2019. The research instrument was the Persian version of the Self-Directed Learning Readiness Scale. Data analysis was performed using SPSS software (version 16), the indicators of descriptive statistics (e.g., mean, frequency, percentage, and standard deviation), linear regression, and Pearson correlation coefficient.

Results: Out of 201 individuals, 46 (22.9%) and 155 (77.1%) students were male and female, respectively. The mean age of the students was 39.93±8.25 years. The mean values of the scores of self-directed learning outcomes and facilitators were 71.8±9.4 (out of 95) and 70.4±10.6 (out of 125), respectively. There was a direct and significant relationship between self-directed learning outcomes and facilitators ($P<0.001$); accordingly, with the increase of the score of facilitators, the score of self-directed learning also increased. Additionally, the variables of outcomes and facilitators had significant relationships with academic achievement ($P<0.001$).

Conclusion: According to the study results, by increasing self-directed learning facilitators, the outcomes of this type of learning, especially students' academic achievement, increased. Therefore, it is recommended to increase students' participation and consolidate self-directed activities. Furthermore, by the application of technology and program appropriate to the subject of the course, professors in virtual training should strengthen and nurture students' self-direction skills and guide them to do various assignments and activities related to their lesson objectives.

Keywords: Facilitators, Self-directed Learning, Students, Medical Education, Academic Achievement

Background

Among the most widely used technologies in the lives of many individuals around the world are communication technologies through the Internet. The Internet has been able to play an effective role in various topics, one of the most prominent of which is the educational aspect. The Internet provides the professor with numerous capabilities to pave the way for new learning environments called

virtual training (1), which has provided many educational benefits, especially in the conditions of the coronavirus crisis; nevertheless, in contrast to virtual training, there is traditional training, which is more professor-centered and based on memorizing the lesson materials and less attention is paid to the student's actual learning (2). By the consideration of these disadvantages, education has tended toward virtual training, the main philosophy of

which is student-centered.

Virtual training is a new distance learning method that has been formed with the expansion of the Internet in the field of higher education (3). In other words, this learning environment is different from face-to-face learning environments in terms of cases, such as being multimedia, accessibility to extensive data, accessibility to various communication facilities, use of synchronous and asynchronous communication tools, and individualization characteristics; therefore, these characteristics impose requirements that the virtual trainee should be able to cope with this new learning environment and, in other words, have specific skills and characteristics (4). Computer and Internet skills, self-learning skills, spontaneity, problem-solving and critical thinking, interest in learning, self-directed skills, ability to establish group communication, questioning power, discussion skills, responsibility, skills of using online learning resources, and applying learning strategies are among these skills and characteristics (5).

Among the above-mentioned skills, the role of inclusive self-direction in the virtual training environment and in general in all technology-based educational environments is very important. Furthermore, several studies have suggested the role of inclusive self-direction in the success of virtual students (6). Self-direction in learning is an educational method widely used in effective educational systems. Self-directed learning can be defined based on the degree of acceptance of inclusive responsibility for individual learning (7). In his famous work, Knowles considers self-direction a process in which learners, with or without the help of others, identify needs, set goals, identify materials and human resources for learning, select and implement appropriate learning strategies, assess their appropriate learning outcomes, and gain the upper hand (8).

The self-directed learning method is designed as a complementary training program (9). This type of learning enables students to adjust their learning processes independently or under the professor's guidance (10). In general, the importance of self-directed learning in virtual training is so that some researchers have suggested the motivation and nurture of self-directed learning in learners as one of the efficiency indicators of virtual training (11, 12). Moreover, with the expansion of online education in the field of medical education, it is necessary to pay attention to the constant changes in the information, the importance of updating knowledge in this field, and nurturing students who are constantly learning during and after their education. Therefore, identifying effective training methods and evaluating their effectiveness is important.

Equipping the students with self-directed learning abilities makes them lifelong learners (13). On the other hand, turning students into self-directed learners is economically beneficial to medical education centers in exchange for spending a large sum of money in the long run (14). According to the results of Edward et al.'s (2015) study, self-directed learning is increasing every

day because online learning is increasingly focused on this type of learning (15). Bill et al. (2008) observed that self-directed learning led to graduation promotion among students with this skill (16). Chen et al. (2014) also stated that self-directed learning was important for students' career advancement and enabled them to expand their knowledge and increase their quality of life and work (17).

Given that self-directed learning in virtual training is a necessity of this type of education, students need to actively participate in the teaching and learning process and give meaning and depth to their learning through individual search and guidance or under the guidance of a professor. Although this type of learning can be considered an irreplaceable opportunity in virtual training, with the presence of individuals in new e-learning spaces, serious problems have been created in educational systems; therefore, success in this type of learning requires using the experiences of students and professors in the context of virtual training and conscious and intelligent management of e-learning environments. It is also necessary to have a thorough recognition of e-learning environments to take advantage of this technology and overcome the bottlenecks beyond it.

Objectives

For this purpose, the present study was conducted to determine self-directed learning outcomes and facilitators in virtual graduate students in the field of medical education.

Methods

This descriptive-analytical cross-sectional study was conducted in the academic year 2019. The statistical population of the study included 205 or 201 graduate in the field of virtual medical education. Who were selected by the census method. The research environment was the virtual faculties of the universities of medical sciences in Tehran, Iran. The data collection instrument was a questionnaire consisting of two parts; the first part contained personal characteristics (age, gender, marital status, basic field of study, university of study, and grade point average [GPA]), and the second part was the Persian version of Self-Directed Learning Readiness Scale involving self-directed learning facilitators (25 items) and outcomes (19 items) based on a five-point Likert scale (from "strongly agree" to "strongly disagree"; score 1 to 5).

The score ranges of self-directed learning facilitators and outcomes were 25-125 and 19-95, respectively. The content validity, face validity, and structural validity of this instrument have been confirmed. Furthermore, Kohan et al. (2017) measured the instrument stability using Pearson correlation coefficient and intra cluster correlation coefficient (0.77) and the instrument internal consistency using Cronbach's alpha coefficient (0.91) (18). In the present study, the reliability of the self-directed learning scale by Cronbach's method was obtained at 0.87 for the total test, 0.77 for the subscale

of self-directed learning outcomes, and 0.76 for self-directed learning facilitators.

In this study, in addition to observing ethical points, receiving the ethical approval code (no.: IR.KMU.REC.1397.493), and obtaining permission from the officials of virtual faculties, coordination and planning were performed with the officials of the education departments and the professors. An explanatory guide was written to attract the cooperation of students, which included the research title and general characteristics and how to use the research results. The questionnaires were anonymous, and the research results were entered anonymously in such a way that by referring the researchers to research units and providing the necessary explanations about the research nature and aims, the questionnaires were distributed among 205 statistical samples of the study at the appropriate time in terms of non-interference with educational programs and considering satisfaction to participate in the study. The students who were not available were also contacted by email regarding the necessity of the study and were asked for necessary cooperation with the mentioned project. In each case, in addition to primary explanations and clarification of how to fill out the questionnaires, the questions asked by the subjects were answered, and the ambiguities were removed. Overall, 201 complete questionnaires (response rate: 98%) were returned in a verifiable manner.

Data collection took about 3 months. Data analysis was performed at two descriptive and inferential levels using SPSS software (version 16). In the descriptive analysis of data, the indicators of descriptive statistics (e.g., mean, frequency, percentage, and standard deviation) were used. Additionally, in the inferential statistical analysis, linear regression was used to examine the relationships between demographic variables and academic achievement, and Pearson correlation coefficient was used to examine the relationship between the two variables of self-directed learning outcomes and facilitators. The significance level of less than 0.05 was considered.

Results

Out of 201 individuals, 46 (22.9%) and 155 (77.1%) subjects were male and female, respectively. Furthermore, 27.9% and 72.1% of the participants were single and married, respectively. Previous educational levels of the participants in this study included 29.4% with medical education and PhD, 35.3% with a bachelor's degree in nursing, 21.4% with a bachelor's degree in midwifery, and 13.9% with other fields of study (i.e., health, medical services management, and educational management). The mean age of the students was 39.93 ± 8.25 years (range: 21-59 years). The mean GPA value of students at the end of the semester was 17.29 ± 1.17 . The mean value of students' self-directed learning outcomes and facilitators were 71.8 ± 9.43 (out of 95) and 70.37 ± 10.60 (out of 125), respectively, which were higher than facilitators regarding the score. According to the results, with a one-year increase in the students' age, the mean score of self-directed learning outcomes significantly increased by 0.23 ($P=0.03$). Furthermore, with a one-point increase in the students' GPA, the mean score of learning outcomes significantly increased by 2.40 ($P=0.004$). Other variables had no significant effect on the score of the outcomes (Table 1).

According to the results, with a one-year increase in the students' age, the mean score of self-directed learning facilitators significantly increased by 0.26 ($P=0.005$). With a one-point increase in the students' GPA, the score of facilitators significantly increased by 1.76 ($P=0.01$). Other variables had no significant effect on the score of the facilitators (Table 2).

Pearson correlation coefficient between the outcomes and facilitators was 0.79, and there was a direct and significant relationship between the two variables of outcomes and facilitators ($P \geq 0.0001$); accordingly, with increasing the score of outcomes, the score of facilitators also increased. The correlation coefficient between the two variables showed the outcomes and facilitators (Figure 1).

Table 1. Relationships between Demographic Variables and Self-directed Learning Outcomes in Virtual Medical Students in 2019

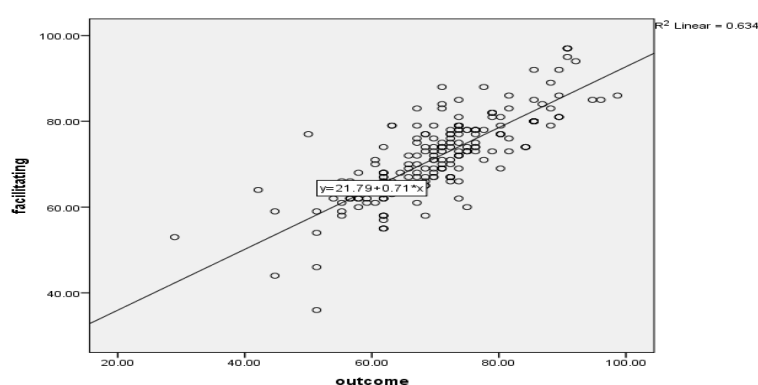
Variable	N (%)	Mean (SD)	Regression coefficient (95% CI)	P	
Gender	Male	46 (22.9)	70.40(1.10)	*	
	Female	155 (77.1)	70.30(1.61)	0.10 (-3.50 and 3.72)	0.95
Marital status	Married	142 (72.1)	69.80(1.07)	*	
	Single	56 (27.9)	70.90(1.67)	1.09 (-2.66 and 4.84)	0.56
Previous field of study	Medicine	59 (29.4)	70.04(1.81)	1.48 (-4.39 and 7.36)	0.62
	Nursing	71 (35.3)	71.75(1.45)	3.19 (-1.56 and 7.96)	0.18
	Midwifery	43 (21.4)	71.05(1.79)	2.49 (-2.63 and 7.61)	0.34
	Others	28 (13.9)	68.56(2.16)	*	
University of study	Iran	41 (20.4)	70.14(1.68)	*	
	Beheshti	126 (62.7)	70.21(1.20)	0.07 (-3.57 and 3.73)	0.96
	Tehran	34 (16.90)	70.70(1.82)	0.56 (-4.13 and 5.25)	0.81
Age (year)		39.93(8.25)	0.23 (0.02 and 0.44)	0.03	
GPA		17.29(1.17)	2.40 (0.77 and 0.04)	0.004	

GPA, grade point average

Table 2. Relationships between Demographic Variables and Self-directed Learning Facilitators in Virtual Medical Education Students in 2019

Variable	N (%)	Mean (SD)	Regression coefficient (95% CI)	P	
Gender	Male	46 (22.9)	72.43(1.42)	*	
	Female	155 (77.1)	70.80(0.96)	-1.62 (-4.80 and 1.54)	0.31
Marital status	Married	145 (72.1)	72.25(0.94)	*	
	Single	56 (27.9)	71.98(1.47)	0.72 (-2.57 and 4.03)	0.66
Previous field of study	Medicine	59 (29.4)	72.30(1.59)	2.82 (-2.34 and 7.99)	0.28
	Nursing	71 (35.3)	73.22(1.280)	3.74 (-0.44 and 7.93)	0.08
	Midwifery	43 (21.4)	71.48(1.58)	2.00 (-2.50 and 6.51)	0.38
	Others	28 (13.9)	69.47(1.90)	*	
University of study	Iran	41 (20.4)	70.874(1.47)	*	
	Beheshti	126 (62.7)	72.44(1.50)	1.57 (-1.63 and 4.78)	0.33
	Tehran	34 (16.90)	71.54(1.47)	0.67 (-3.44 and 4.80)	0.74
Age (year)			39.93(8.25)	0.26 (0.07 and 0.44)	0.005
GPA			17.29(1.17)	1.79 (0.35 and 3.23)	0.01

GPA, grade point average

**Figure 1.** Relationship Between Self-directed Learning Outcomes and Facilitators in Virtual Medical Education Students in 2019

Discussion

Self-directed learning is a basic capacity in a virtual training environment, the facilitation of which helps students use all their senses and power to learn. Based on the results of the present study, the scores of self-directed learning facilitators were at a relatively good level, and the mean score of learning outcomes was also at a high level. There was a direct and significant relationship between the mean scores of self-directed learning facilitators and outcomes; accordingly, with the increase in the score of facilitators, the score of self-directed learning also increased.

Educational content, guidance by professors, methods and facilities, flexibility, choice power, and time management in this type of training have provided a suitable educational environment for virtual students. The results of the studies performed by Shen et al. (2014), Kohan et al. (2017), and Saeid et al. (2016) are in line with the results of the present study (17, 18, 19).

Cazan et al. (2014) and Lounsbury (2012) believe that virtual training affects learners' personality traits, encourages them to progress, and increases learning self-control, self-regulation skills, and adaptation and meditation in cyberspace (20, 21). Keshavarz et al. (2013)

also showed that learners learned materials deeper in the process of e-learning (22), and their self-confidence increased in a positive direction (19), indicating that facilitating self-directed learning had positive outcomes in the field of the learning process.

In the present study, there was also a significant relationship between self-directed learning facilitators and the academic achievement of virtual students; accordingly, with the increase of students' GPA, the mean score of facilitators significantly increased. Therefore, the learning facilitators led to students' academic achievement. There was also a significant relationship between self-directed learning outcomes and academic achievement. In other words, as self-directed learning outcomes increased, academic achievement also increased.

Abdullah (2019), Hsu (2005), and Bail et al.'s (2008) studies, which are consistent with the present study, suggest that self-directed learning not only brings high academic achievement but also leads to the promotion of graduates possessing this skill (23, 16, 24). Since e-learning is viewed as one of the self-directed learning facilitators, due to using this modern communication technology, education goes beyond the limits of time and space, and the student receives information resources more rapidly. Additionally, with the help of this technology, learning time will be

reduced by combining audio, video, and text, will pass better, and can lead to students' academic progress. The results of Cazan (2014), Malta et al. (2010), and Fidalgo et al.'s (2014) studies are in line with the findings of the current study, showing that facilitators (e.g., e-learning, movies, and moving pictures) are significantly related to the student's academic performance (20, 25, 26).

In this study, the analysis of the mean scores of self-directed learning facilitators and outcomes with students' characteristics indicated that both variables had direct statistical relationships with age ($P \leq 0.05$). Considering the necessity of knowledge and awareness to pass the course of study among older students through e-learning and the use of various facilitators during their education and work, these students consequently gain higher points than younger students. Furthermore, older students have relatively passed the excitement stemmed from the surrounding environment, are more aware of their ultimate goal of learning (i.e., acquiring knowledge and skill from such an environment), and therefore dedicate more time to study and improve their academic performance. In other words, by increasing the age of learners, self-directed learning outcomes also increase.

The high level of self-directed learning outcomes in older students can be attributed to the experience, self-awareness, responsibility, more interactions, and the increase of learning skills in these students. On the other hand, with an increase in age, individuals become less dependent on others, and learning methods gradually become normal for each person; therefore, they feel they have to change and move toward more self-direction. A study performed by Nadi et al. (2013) showed a significant relationship between students' age and self-directed learning; accordingly, older students had higher self-direction skills, which is consistent with the results of the present study (27).

In Abraham et al.'s study (2011), which is consistent with the present study, a significant difference was observed between the self-directed learning test score and the participants' age (28). Nevertheless, in Litzinger et al.'s study (2005), no significant relationship was observed between the self-directed learning readiness test scores in different age groups (29). There was no difference between self-directed learning facilitators and other demographic characteristics (i.e., gender, the previous field of study, and the university of study) (25). In Ahanchian et al.'s study (2015), there was no significant difference between the total score of self-directed learning in male and female students, which is consistent with the findings of the current study (30).

In today's world, learning and training cannot be limited to the classroom space. In addition, virtual training is inevitable in the conditions of coronavirus disease 2019 and is recognized as a capacity in universities in the post-corona conditions; therefore, strengthening and facilitating self-directed learning due to learner-centered development is the primary responsibility of professors and educational officials. On the other hand, given that the

research units in this study were virtual graduate students (with a master of medical education) with educational backgrounds in different areas of medical sciences, they were relatively talented with a mastery of self-direction skills, which is one of the limitations of our study. Therefore, it is recommended to perform this study on other groups and educational levels to better perceive the existing problems.

Conclusion

Self-direction is one of the important factors of academic achievement and blessing in disguise, especially in virtual training. According to the results of the present study, with the increase of self-directed learning facilitators, the outcomes of this type of learning, especially students' academic achievement, increase. Therefore, it is recommended to increase students' participation and consolidate self-directed activities. Furthermore, by the application of technology and program appropriate to the subject of the course, professors in virtual training should strengthen and nurture students' self-direction skills and guide them to do various assignments and activities related to their lesson objectives.

Supplementary Material(s): Is available here [To read supplementary materials, please refer to the journal website and open [PDF/HTML](#)].

Acknowledgments: This study is the result of a part of a master's thesis in medical education approved at Kerman University of Medical Sciences, Kerman, Iran. The authors would like to express their gratitude to all the officials who helped carry out this research project. Moreover, the authors fully appreciate all the students of virtual training participating in this study. Due to the fact that the research community was limited to virtual master students, so in generalizing the result to other situations, care should be taken.

Conflict of Interests: The authors declare that they have no competing interests.

Ethical Approvals: This study was approved at Kerman University of Medical Sciences, code of ethics (no.: IR.KMU.REC.1397.493)

Funding/Support: No funding.

References

- Shieh C-J, Yu L. A Study on Information Technology Integrated Guided Iscovery Instruction towards Students' Learning Achievement and Learning Retention. *Eurasia Journal of Mathematics, Science & Technology Education*. 2016;12(4):833-42.
- Nourian A, Nourian A, Ebnahmadi A, Akbarzadeh Bagheban A, Khoshnevisan MH. Comparison of E-learning and Traditional Classroom Instruction of Dental Public Health for Dental Students of Shahid Beheshti Dental School during 2010-2011. *J Dent Sch*. 2012;30(3):174-83. [In Persian]
- Allen IE, Seaman J. *Going the distance: Online education in the United States, 2011*. Sloan Consortium. Babson Park, Massachusetts: Babson Survey Research Group; 2011.

4. Drachler H, Hummel H, Van den Berg B, Eshuis J, Waterink W, Nadolski R, et al. Effects of the ISIS Recommender System for navigation support in self-organised Learning Networks. *Journal of Educational Technology & Society*. 2009;12(3):106-24.
5. Beyrer GM. Online student success: Making a difference. *Journal of Online Learning and Teaching*. 2010;6(1):89-100.
6. Hernández R, Rankin P. Higher education and second language learning: promoting self-directed learning in new technological and educational contexts. Bern: Peter Lang; 2015. doi:10.3726/978-3-0353-0685-9.
7. Rashid T, Asghar HM. Technology use, self-directed learning, student engagement and academic performance: Examining the interrelations. *Computers in Human Behavior*. 2016;63:604-12. doi:10.1016/j.chb.2016.05.084.
8. Morris TH. Adaptivity through self-directed learning to meet the challenges of our ever-changing world. *Adult Learning*. 2019;30(2):56-66. doi:10.1177/1045159518814486.
9. Tao Y, Li L, Xu Q, Jiang A. Development of a nursing education program for improving Chinese undergraduates' self-directed learning: A mixed-method study. *Nurse Educ Today*. 2015 Nov;35(11):1119-24. doi: 10.1016/j.nedt.2015.05.016. [PMID: 26070480].
10. Nasri NM, Mydin F. University students' view of self-directed learning in an online learning context. *Advances in Social Sciences Research Journal*. 2017;4(24):124-17. [In Persian]
11. Kim RH. (dissertation). Self-directed learning management system: Enabling competency and self-efficacy in online learning environments. Claremont, US: The Claremont Graduate University; 2010.
12. Spormann RC, Perez VC, Fasce HE, Ortega BJ, Bastias VN, Bustamante DC, et al. Factors associated with self-directed learning among medical students. *Rev Med Chil*. 2015 Mar;143(3):374-82. doi: 10.4067/S0034-98872015000300013. [PMID: 26005825].
13. Noohi E, Jahantighi J, Torabi Parezi M, Ramezani A, Ramazani V. Evaluation of the Effect of Problem-based Teaching on Self-directed Learning Readiness of Dentistry Students at Kerman University of Medical Sciences. *Journal of Zabol University of Medical Sciences and Health Services*. 2015;6(4):34-41. [In Persian]
14. McGrath D, Crowley L, Rao S, Toomey M, Hannigan A, Murphy L, et al. Outcomes of Irish graduate entry medical student engagement with self-directed learning of clinical skills. *BMC Med Educ*. 2015 Feb 19;15:21. doi: 10.1186/s12909-015-0301-x. [PMID: 25890332]. [PMCID: PMC4336507].
15. De Waard I, Kukulska-Hulme A, Sharples M. Investigating self-directed learning dimensions: adapting the Bouchard Framework. Cham: Design for Teaching and Learning in a Networked World. Spain, Springer; 2015: 395-400. doi:10.1007/978-3-319-24258-3_30.
16. Bail FT, Zhang S, Tachiyama GT. Effects of a self-regulated learning course on the academic performance and graduation rate of college students in an academic support program. *Journal of college reading and learning*. 2008;39(1):54-73. doi:10.1080/10790195.2008.10850312.
17. Shen W-Q, Chen H-I, Hu Y. The validity and reliability of the self-directed learning instrument (SDLI) in mainland Chinese nursing students. *BMC Med Educ*. 2014 May 27;14:108. doi: 10.1186/1472-6920-14-108. [PMID: 24885557]. [PMCID: PMC4087248].
18. Kohan N. Developing Conceptual Model of Self-directed Learning in Virtual Environment and Designing an Evaluation Tool. Tehran: Tehran University; 2017. [In Persian]
19. Saaid N, Eslaminejad T. Relationship between student's self-directed-learning readiness and academic self-efficacy and achievement motivation in students. *International Education Studies*. 2016;10(1):225-32. doi.org/10.5539/ies.v10n1p225.
20. Cazan AM, Schiopca BA. Self-directed learning, personality traits and academic achievement. *Procedia Soc Behav Sci*. 2014; 127:640-4.
21. Lounsbury JW, Levy JJ, Park S-H, Gibson LW, Smith R. An investigation of the construct validity of the personality trait of self-directed learning. *Learn Individ Differ*. 2009;19(4):411-8. doi:10.1016/j.lindif.2009.03.001.
22. Keshavarz M, Rahimi M, Esmaili Z. The Effect of e-Learning on the Academic Development of University Students. *Journal of Torbat Heydariyeh University of Medical Sciences*. 2013;1(2):13-21. [In Persian]
23. Abdullah J, Mohd-Isa WN, Samsudin MA. Virtual reality to improve group work skill and self-directed learning in problem-based learning narratives. *Virtual Reality*. 2019;23(4):461-71. doi:10.1007/s10055-019-00381-1.
24. Hsu YC, Shiue YM. The effect of self-directed learning readiness on achievement comparing face-to-face and two-way distance learning instruction. *International Journal of Instructional Media*. 2005 Apr 1; 32(2):143.
25. Malta S, Dimeo SB, Carey PD. Self-direction in learning: does it change over time?. *J Allied Health*. Summer 2010;39(2):e37-41. [PMID: 20539919].
26. Fidalgo-Neto AA, Alberto AVP, Bonavita AGC, Bezerra RJS, Berçot FF, Lopes RM, et al. PHARMAVIRTUA: educational software for teaching and learning basic pharmacology. *Adv Physiol Educ*. 2014 Dec;38(4):368-71. doi: 10.1152/advan.00033.2014. [PMID: 25434022].
27. Nadi MA. Medical and Dentistry Students' Perceptions of Self directed Learning and its Relationship with Personal Traits. *Strides Dev Med Educ*. 2012;8(2):173-81. [In Persian]
28. Abraham RR, Fisher M, Kamath A, Izzati TA, Nabila S, Atikah NN. Exploring first-year undergraduate medical students' self-directed learning readiness to physiology. *Adv Physiol Educ*. 2011 Dec;35(4):393-5. doi: 10.1152/advan.00011.2011. [PMID: 22139776].
29. Litzinger TA, Wise JC, Lee SH. Self-directed Learning Readiness Among Engineering Undergraduate Students. *Journal of Engineering Education*. 2005;94(2):215-21. doi:10.1002/j.2168-9830.2005.tb00842.x.
30. Ahanchian MR, Assarroudi A. The relationship between decision-making style and self-directed learning in anesthesiology students. *Military Caring Sciences*. 2015;2(1):24-32. [In Persian]. doi:10.18869/acadpub.mcs.2.1.24.