Int. J. Morphol.,
41(2):600-606, 2023.

Scale to Measure Medical, Nursing and Midwifery Students' Engagement in an E-learning Histology Course

Escala para Medir la Participación de Estudiantes de Medicina, Enfermería y Obstetricia en un Curso de Histología E-learning

Gonzalez Donoso A.[1,2]; Jara-Rosales S.[3]; Padilla-Meza J.[2] & Godoy-Guzmán C.[2,4]

GONZALEZ D. A.; JARA-ROSALES, S.; PADILLA-MEZA, J. & GODOY-GUZMÁN, C. Scale to measure medical, nursing and midwifery students' engagement in an e-learning histology course. *Int. J. Morphol., 41(2)*:600-606, 2023.

SUMMARY: E-learning courses become increasingly important and relevant in medicine and health sciences over the last decade. However, there are few teaching experiences of e-learning histology courses published in the literature worldwide. Moreover, most of these studies focus on the didactic aspects of the course without exploring student participation. The study presented below aimed to validate a scale to measure student participation in an e-learning histology course. We provide evidence of validity of the instrument based on its internal structure for use with medical, nursing, and midwifery students. The participants in this study were a group of 426 Chilean medical, nursing and midwifery students from a public university who completed the questionnaire in two consecutive semesters (2020-2021). Data from the first group of students were used to perform an exploratory factor analysis (EFA), while data from the second group of participants were used to perform a confirmatory factor analysis (CFA). The three factors identified according to the CFA were: "Habits of online," "Motivation for online learning," and "Interaction of online". After eliminating one of the initial items of the instrument, the scale showed acceptable psychometric properties suggesting that it is a useful instrument to measure students' perception of their participation in e-learning histology courses. The factors identified through the validation of the instrument provide relevant information for teachers and curriculum developers to create and implement different ways of encouraging student participation in e-learning histology courses to support online learning.

KEY WORDS: Medical education; Health professions education; Histology; e-learning.

INTRODUCTION

Traditionally, Chile's education system at the university level for medical students follows a face-to-face approach of teaching that integrates lecture-based teaching and practical activities such as laboratories (Toledo-Ordoñez *et al*., 2022) and clinical simulation (Jara-Rosales *et al*., 2020). However, e-learning courses have become more important and relevant during the last decade in medicine and health sciences (Farrell & Brunton, 2020; Jara-Rosales *et al*., 2022). In an e-learning course, the total content of the subject, or educational program, is delivered through the virtual classroom. That is, the study of the disciplinary content, schedules and dates of assignments, assessment instruments and all types of interaction occur in the virtual environment (Zhao *et al*., 2015). In addition, this interaction can occur through two types of activities: synchronous and asynchronous. Synchronous activities are those in which students and teacher interact using the platform at the same time (Srinivasan, 2020). Live lessons, video calls, chats, assignments, evaluations, and different types of interactions can be carried out, in which the main advantage is the delivery of instant feedback from the teacher. Students also interact with each other, being able to work together in group activities. On the contrary, asynchronous activities are those in which the teacher delivers content in the form of lessons, activities, or evaluations that students can perform autonomously with dates and times deferred or defined by the teacher in advance. In this type of asynchronous model, the

[1] University of British Columbia, Faculty of education, Department of curriculum and pedagogy, Ph.d Curriculum Studies, Vancouver, Canada.
[2] Universidad de Santiago de Chile (USACH), Escuela de Medicina, Unidad de Histología, Santiago, Chile.
[3] Escuela de Obstetricia, Facultad de Ciencias para el Cuidado de la Salud, Universidad San Sebastián, Sede Los Leones, Santiago, Chile; Programa de Doctorado en Enfermedades Crónicas, Universidad San Sebastián, Sede Los Leones, Santiago, Chile
[4] Universidad de Santiago de Chile (USACH), Escuela de Medicina, Centro de Investigación Biomédica y Aplicada (CIBAP), Laboratorio de ingeniería de tejidos, Santiago, Chile.
This work was funded by the Universidad de Santiago's Research Vice-Rectory (PID, Nº 002-2020).

Received: 2023-01-04 Accepted: 2023-02-09

advantage of immediate feedback is lost, but an important barrier to e-learning, such as the students' time availability, is overcome. Bell & Federman (2013) point out that the effectiveness of an e-learning course depends on three key aspects. First, the implementation and development conditions must remain stable throughout the entire duration of the course. Second, it is necessary to configure or manage its features, such as depth or interactivity, as they can help learners achieve different types of knowledge. Third, it is necessary to overcome the different barriers that teachers face in the implementation and development of this methodology. Some examples of these barriers are: concern about fraud or students cheating during the activity and concern about the challenges faced by lower-income students.

In the context of medical and health sciences subjects, the experiences published in the literature on e-learning courses are positive (Barbeau *et al*., 2013; Lavender *et al*., 2013; Antonoff *et al*., 2014; Arbour *et al*., 2015; Jayakumar *et al*., 2015; Srinivasan, 2020; Jara-Rosales *et al*., 2022; Wilhelm *et al*., 2022). Among the benefits described, we can identify that it allows students to study subjects when there are geographical difficulties (long distances) (Bell & Federman, 2013); to access them in an easy and friendly way (e.g., Moodle, Canvas) (Godoy-Guzman *et al*., 2019); to manage their learning at their own pace, thus making study time compatible with their family life (McVeigh, 2009). In a complementary way, e-learning courses can strengthen teamwork and improve academic performance, as long as the interaction with the teacher is carried out effectively and continuously (Prasad *et al*., 2020). Also, e-learning courses facilitate learning and collaborative work. Nevertheless, this depends on indispensable elements, such as access to computers and stable internet connection (Moule *et al*., 2010; Prasad *et al*., 2020). Notwithstanding the importance and usefulness of e-learning courses in different contexts (e.g., pandemic), there are few teaching experiences of e-learning histology courses published in the world literature, and most of them are focused on the didactic aspects of the course without exploring student participation (Barbeau *et al*., 2013; Darici *et al*., 2021).

Since early 2020, medical schools had to restructure their curriculum and adapt their instruction into an e-learning format. As the pandemic progressed, in-person lectures and laboratory classes were taught mostly remotely which had a profound impact on medical student education and health professions education (Stetson *et al*., 2020). Medical schools were forced to implement abrupt and unforeseen changes to guarantee students' learning. Although medical schools quickly switched to fully online teaching, many courses have been restructured in terms of format, but they still preserve a traditional approach of teaching focused on conveying content information (Stoehr, *et al*., 2021; Jara-Rosales *et al*., 2022). In this context, the COVID-19 pandemic offered and opportunity to assess the participation of Chilean students in an e-learning histology course. The collected information from our study may be useful to improve the design and assessment of e-learning histology courses. This study aimed to validate a scale to measure student participation in an e-learning histology course to assess their learning.

METHODOLOGY

Design and sample. This observational study was conducted with first- and second-year medical, midwifery, and nursing students, who were attending a histology course at Universidad de Santiago de Chile as part of their degree program. A total of 426 students participated in the study, which was approved by the University Ethics Committee of Universidad de Santiago de Chile.

I**nstrument and procedure.** The first phase of this study involved the construction of the scale to measure students' engagement in an online course. We adapted Dixson's (Dixson, 2015) Online Student Engagement Scale (OSE) to measure student engagement in online courses. This scale was slightly modified and translated into Spanish. We did not conduct back-translation to English since we adapted the OSE to align with the modifications that we implemented in the course as a response to the COVID-19 pandemic. Traditionally, the histology course in the university that we conducted the study involves lectures and laboratory sessions; however, because of the pandemic, the new online course consisted of i) pre-recorded video lectures, ii) teacher assistantship in which 3-4-year students monitored students' work and clarified their doubts, iii) feedback sessions, and iv) lecture-based sessions that students attended remotely. The course design incorporated synchronous and asynchronous activities. The design and development of the histology e-learning course was based on the recommendations of several authors (Evans *et al*., 2020; Pather *et al*., 2020). We called the adapted version of the questionnaire Student Engagement in an Online Histology Course Some of these items were modified versions of the OSE. For example, in the OSE, item 11 stated "Really desiring to learn the material"; however, in the SEOHC, we included item "11. Discussions, chats and/or interactions with teachers motivated me to learn more." Appendix A shows the full version of the instrument. To provide content validity, we sent the questionnaire to five experts (medical technologists, a surgeon, and two Ph. D. in biomedical sciences). They were asked to score each item included in the questionnaire: 0 if the item was not essential and 1 if the item was essential. To explore the level of agreement between raters we used Gwet's AC1, which ranges from -1 to 1 (Gwet, 2001). The results showed a

high level of agreement (.893). The SEOHC questionnaire included 18 items. Finally, students were asked to answer the questionnaire about their commitment and participation in the course and indicate to what extent they agree with each statement. A 5-point Likert (1 = Strongly disagree to 5 = Strongly agree) scaling system was implemented.

Statistical analysis. The data was analyzed using R. We analyzed the descriptive statistics of the data, and then conducted an exploratory factor analysis (EFA) with a sample of 272 students. Direct oblimin rotation and maximum likelihood factoring were carried out as the extraction method (Fabrigar *et al.*, 1999). The analysis was conducted using the psych package in R. The Kaiser-Meyer-Olkin (KMO) test and Bartlett's test of sphericity were performed to evaluate factorability (Dziuban & Shirkey, 1974). Tucker-Lewis Index of factoring reliability (TLI) (Bentler, 1990), Comparative Index (CFI), and Root Mean Square Error of Approximation (RMSEA) (10) were used as criteria to examine the goodness-of-fit of the model with the data set. Finally, Cronbach's a was calculated to indicate the reliability of the factors.

Confirmatory factor analysis (CFA) was carried out with a sample of 154 students to examine the factorial structure. Afterwards, model fit was assessed by comparing the statistics AIC (Akaike Information Criteria), BIC (The Bayesian of Schwarz) to select the best model (models with lower values indicate a better fit of the model), and the statistics c2, CFI, TLI, RMSEA, and SRMR were used to analyze the fit model.

RESULTS

The study recruited 426 students who agreed to participate. Table I shows the descriptive statistics of the items included in the SEOHC.

Bartlett's test indicated correlation adequacy, χ^2 (153) = 1817.132, p < .001, and the KMO test indicated sampling adequacy, MSA = 0.88. No correlations above .90 were identified and assumptions were also met. Based on the

Table I. Descriptive statistics of the 18-item included in the SEOH.

Item	1	2	3	4	5	M	SD	skew	kurtosis
1. I made sure to study regularly.	0.70	4.69	22.54	53.05	19.01	3.85	0.8	-0.59	0.51
2. I made an effort to learn in each class.	1.41	8.92	33.57	45.54	10.56	3.55	0.85	-0.42	0.11
3. I kept abreast of the readings.	0.70	0.94	15.02	41.31	42.02	4.23	0.79	-0.89	0.88
4. I reviewed the class notes (PowerPoint, videoconferences) to understand the material before connecting to the online class.	5.87	17.14	37.09	28.64	11.27	3.22	1.05	-0.17	-0.46
5. I was organized when studying	1.64	2.58	9.39	28.40	57.98	4.38	0.88	-1.63	2.66
6. I took notes about the classes, PowerPoints or video lectures	1.17	3.99	8.69	32.39	53.76	4.34	0.88	-1.46	1.99
7. I listened and carefully read the course material.	2.35	12.68	27.93	37.32	19.72	3.59	1.02	-0.39	-0.47
8. I am able to apply the course material to my future professional life.	0.47	4.23	13.62	40.14	41.55	4.18	0.86	-0.94	0.52
9. I found ways to make the course interesting to me.	1.17	4.46	16.20	35.92	42.25	4.14	0.92	-0.97	0.54
10. I was interested in learning the material included in the course.	3.99	8.22	27.00	31.92	28.87	3.73	1.09	-0.59	-0.27
11. Discussions, chats and / or interactions with teachers motivated me to learn more.	0.94	3.05	11.97	48.12	35.92	4.15	0.82	-1.03	1.47
12. I actively participated actively in discussion groups with the assistant instructor.	2.11	3.05	11.03	37.56	46.24	4.23	0.91	-1.37	1.96
13. I helped my classmates understand the contents of the course.	0.00	2.35	10.56	42.96	44.13	4.29	0.75	-0.86	0.37
14. I was motivated by getting a good grade in the course.	1.17	3.52	13.62	43.43	38.26	4.14	0.86	-1.04	1.16
15. I had good grades in my evaluations.	0.94	3.52	9.62	33.33	52.58	4.33	0.86	-1.37	1.77
16. I participated in conversations regarding the contents of the online course (chat, discussions, e-mail).	8.22	16.90	35.92	23.94	15.02	3.21	1.14	-0.13	-0.65
17. I posted on the discussion forum regularly.	0.47	3.76	17.84	47.65	30.28	4.04	0.82	-0.68	0.32
18. I met or interacted with students in the class.	3.99	6.10	25.12	35.21	29.58	3.8	1.06	-0.73	0.08

Note: 1 = Strongly disagree, 2 = Disagree, 3 = Undecided, 4 = Agree, 5 =Strongly agree.

comparison of EFA models, a 3-factor model was preferred. After testing all 18 items, two items were eliminated from further analysis because their factor loadings were smaller than .300. Hence, another 3-factor model was tested. Factor loadings are included in Table II. The indices of goodness-of-fit were as follows. RMSEA indicated an acceptable fit of 0.065, 90% CI [.049, .077], RMSR with good fit (0.04), with CFI value close to 0.95 which shows a relatively good fit (0.947), and acceptable TLI (0.915). The reliability for factor 1 (α = 0.83; *M* = 4.1; SD = 0.65) and 2 (α = 0.82; *M* = 3.9; SD = 0.75) was good. Factor 3 showed acceptable reliability (α = 0.69; *M* = 3.4; SD = 0.91). The extraction of three factors accounted for 46 % of the variance (Factor 1 = 20 %; Factor 2 = 14%; Factor 3= 12 %).

After conducting the EFA, the three-factor CFA model was examined. Maximum Likelihood estimation was used to model the data. Table III shows the published standards for the interpretation of fit indices and summarizes the results from the CFA before and after revising the model. Global fit indices were acceptable (CFI= .940; TLI= .927; SRMR= .059; RMSEA= .058, 90%CI [.039, .076]. Modification Indices (MI) and Expected Parameter Change (EPC) were examined. The largest modification index (MI= 11.747; EPC= 0.112), suggested that only items 2 and 6 should have correlated residuals. We decided to discard item 2 because students' effort might have been ambiguous to interpret. The inspection of the revised model showed that AIC and BIC values had a significantly better model fit (AIC = 5736.499; BIC; 5836.287) compared to the original three-factor model (AIC = 5955.430; BIC = 6050.266).

Table II. Item Factor Loadings for each Factor Solution for SEOHC.

Item	Factor 1	Factor 2	Factor 3
1	**0.79**	0.06	-0.04
5	**0.69**	0.10	-0.05
3	**0.68**	-0.10	0.09
6	**0.65**	-0.15	-0.06
7	**0.65**	0.04	0.02
2	**0.58**	0.10	0.14
4	**0.32**	0.15	0.10
9	-0.02	**0.97**	-0.03
10	0.20	**0.60**	0.09
11	0.10	**0.42**	0.19
8	0.21	**0.35**	0.21
14	0.12	**0.33**	0.26
13	-0.04	0.06	**0.73**
16	0.07	-0.07	**0.65**
12	0.03	-0.11	**0.54**
18	-0.06	0.12	**0.49**

The three factors identified according to the CFA were "Habits of online learners", "Motivation for online learning" and "Interaction of online learners".

DISCUSSION

Over the last years, online learning is one of the fastest growing fields in education worldwide because it facilitates access to students who have difficulties are an unable to attend face-to-face classes (Farrell & Brunton, 2020). Especially during the pandemic of COVID-19, online teaching emerged as the most feasible way to replace face-to-face lectures and laboratory practices. To measure students' engagement in an e-learning histology to assess their learning, we validated and implemented a new instrument called, Student Engagement in an Online Histology Course, which was an adapted version of the Online Student Engagement Scale (OSE) (Dixson, 2015).

With regard to the content validity of the SEOHC, we refined the items included in the questionnaire based on comments by experts in subject contents. Based on the EFA, we identified three factors. The first factor accounted for 20 % of the variance and analyzed «Habits of online» The findings in our study showed that more than 80 % strongly agreed and agreed that they were organized when studying

Table III. Confirmatory Factor Analysis.

Statistic	Poor	Acceptable	Good	Initial Model	Revised Model
x^2	NA	NA	NA	153.339	132.185
x^2 p-value	>.005	≤ 0.05	≤ 0.01	.001	.001
Df	NA	NA	NA	101	87
x^2/df	>5.0	2.0 – 5.0	< or =2	1.518	1.519
CFI	<.90	>.9	>.95	.940	.940
TLI	<.90	>.9	>.95	.929	.927
SRMR	>.1	.06 -.08	<.05	.059	.059
RMSEA	>.1	.06 -.08	<.05	.058, 90%CI [.039, .076]	.058, 90%CI [.037, .078]
AIC	NA	NA	NA	5944.430	5736.499
BIC	NA	NA	NA	6050.266	5836.287

Note: CFI = Comparative Fit Index; TLI = Tucker-Lewis Index; SRMR = Root Mean Square Residual; Root Mean Square Error = Residuals; AIC = Akaike Information Criterion; BIC = Schwarz Bayesian Information Criterion.

(item 5); took notes about the class (item 6) and kept abreast of the readings (item 3); and made sure to study regularly (item 1). Just over half of the students strongly agreed and agreed that i) they listened and carefully read the course material (item 7; 57.04 %) and ii) they made an effort to learn in each class (item 2; 56.10 %). Surprisingly, only about 40 % of the students strongly agreed and agreed that they reviewed the class notes to understand the material before connecting to the online course (item 4; 39.91 %). This finding might reveal that some students expect to be taught in class instead of preparing effectively for the lecture's content and being active in class by asking questions. This finding is in line with other research findings on the relationship between student habits and their engagement in online courses. In the context of study habits of undergraduate students during the pandemic of COVID-19, in a study with 555 undergraduate students in the UK, Aristeidou & Cross (2021) found that students' difficulties in managing workload was another aspect that had a negative impact on study habits. This result is in line with Ibrahim *et al*. (2021) study that showed that about 40 % of the medical students (N = 340) agreed that lack of self-discipline to e-learning is an important barrier in e-learning during the COVID-19.

The second factor inquiries about «Motivation for online» Overall, students had a high perception about their motivation in online learning. Four out of the 5 items included in this factor, the findings showed that four-fifths of the students strongly agreed and agreed that i) discussions, chats and/or interactions with teachers motivated them to learn more (item 11; 84.04 %), ii) were able to apply the course material to their future professional life (item 8; 81.69 %), iii) were motivated by getting a good grade in the course (item 14; 81.69 %) and iv) found ways to make the course interesting to them (item 9; 78.17 %). Moreover, almost two-thirds strongly agreed and agreed that they were interested in learning the material included in the course (item 10; 60.79 %). In education, students' motivation is pivotal since it might determine what they learn, how they learn, and when they choose to learn (Schunk *et al*., 2008). Because we conducted this study during the COVID-19 pandemic, almost all educational institutions in Chile were forced to adapt their instruction to an online format. Hence, the popularity of online courses among medical students increased significantly, while traditional courses had to adapt as a response to this emergency. It is worth mentioning that more than the teaching format, online versus face-to-face teaching, research suggests that teaching type is one of the variables that might predict students' motivation in class (Hwang & Kim, 2006). In this sense, we assume that the pedagogical strategies implemented in the online course might have impacted students' motivation. In other words, we are cautious in interpreting the results since we acknowledge that merely recording lectures and uploading them into Moodle it might have not reflected a significant change in the approach of teaching. In this sense, our e-learning histology course involved different activities such as synchronous and asynchronous lectures, feedback sessions and forums instead of just being a digital repository of slides and pre-recorded lectures.

The third factor is referred to «Interaction of online». Table I shows that a large majority of the students (87.09 %) strongly agreed and agreed that they helped their classmates to understand the content of the course (item 13). A similar percentage was observed in question 12, in which more than 80 % of the students strongly agreed and agreed that they actively participate in the discussion groups with the assistant instructor. Surprisingly, these findings contrast with item 16 in which just over a third (38.96 %) of the students strongly agreed and agreed that they participated in conversations regarding the contents of the online course (chat, discussions, email). The results of item 16 encourage us to explore how future versions of the histology course can include activities in which students are challenged to create a community of learning. It seems that many students only participate in class when summative assessment is implemented or when there is an instructor guiding the activity (see results for item 12). In other words, these formative instances in which students can discuss with their classmates in forums and interact with others are not often used by them if the activities are not formatively or summatively assessed by the instructors. It is also worth noting that just under two-thirds of the students (64.79 %) strongly agreed and agreed that they met or interacted with students in the class (item 17). These results are informative for the development of the histology course that we implemented since student-to-student interaction is an important component in effective e-learning teaching and learning (Rovai & Barnum, 2007). Moreover, less frequent interaction with students has shown a negative and significant impact on their learning activities and their academic performance (Aristeidou & Cross, 2021). It is also worth mentioning that online teaching during the COVID-19 has been perceived among medical students as an approach of teaching that lacks interpersonal interaction and therefore, a traditional approach of teaching is often preferred (Hameed *et al*., 2020). For example, AlQhtani *et al*. (2021) by applying a cross-sectional online survey measured 376 medical students' effectiveness and satisfaction in online courses during COVID-19. These scholars found that students perceived these online courses as less effective in terms of including building skills and knowledge and student interaction. In the design of our course, we included synchronous classes and feedback sessions, which fostered a sense of community by encouraging students and teaching assistants to interact with each other. For example, we

provided students with online resources and asked them to use a virtual microscope to recognize and discuss how the morphology of cells and tissues is determined by their function. Then, they were asked to discuss in groups, being monitored by teaching assistants during each practical activity.

Finally, the SEOHC questionnaire is a useful and innovative instrument that allows assessing the perception of medical and health science students about their participation in a histology course implemented in e-learning format. The scale showed acceptable psychometric properties and is a useful instrument to assess students' perception of their participation in e-learning histology courses. Thus, to stimulate the participation of students, teachers and curriculum developers should explore new ways to support effective e-learning histology courses.

GONZALEZ D. A.; JARA-ROSALES, S.; PADILLA-MEZA, J. & GODOY-GUZMÁN, C. Escala para medir la participación de estudiantes de medicina, enfermería y obstetricia en un curso de histología e-learning. *Int. J. Morphol., 41(2)*:600-606, 2023.

RESUMEN: Los cursos e-learning han tomado mayor importancia y relevancia durante la ultima década en carreras de medicina y ciencias de la salud. No obstante, existen escasas experiencias docentes de cursos de histologia e-learning publicadas en la literatura mundial. Además, la mayoría de estos estudios se centran en los aspectos didácticos del curso sin explorar la participación de los estudiantes. El estudio que presentamos a continuación tuvo por objetivo validar una escala para medir la participación de los estudiantes en un curso de histología e-learning. Aportamos evidencia de validez del instrumento basada en su estructura interna para su uso con estudiantes de medicina, enfermería y obstetricia. Los participantes de este estudio fueron un grupo de 426 estudiantes chilenos de medicina, enfermería y obstetricia de una universidad pública quienes completaron el cuestionario en dos semestres consecutivos (año 2020-2021). Los datos del primer grupo de estudiantes se utilizaron para realizar un análisis factorial exploratorio (AFE), mientras que los datos del segundo grupo de participantes se utilizaron para realizar un análisis factorial confirmatorio (AFC). Los tres factores identificados según el AFC fueron: "Hábitos de los estudiantes en línea", "Motivación por el aprendizaje en línea", "Interacción de los estudiantes en línea". Luego de la eliminación de uno de los ítems iniciales del instrumento, la escala mostró propiedades psicométricas aceptables sugiriendo que es un instrumento útil para medir la percepción de los estudiantes sobre su participación en cursos de histología en formato e-learning. Los factores identificados mediante la validación del instrumento entregan información relevante para que los profesores y curriculistas desarrollen e implementen diferentes formas de estimular la participación de los estudiantes en cursos de histología e-learning y así apoyar el aprendizaje en formato online.

PALABRAS CLAVE: Educación médica; Educación en ciencias de la salud; Histología; e-learning.

REFERENCES

AlQhtani, A.; AlSwedan, N.; Almulhim, A.; Aladwan, R.; Alessa, Y.; AlQhtani, K.; Albogami, M.; Altwairqi, K.; Alotaibi, F.; AlHadlaq, A.; *et al.* Online versus classroom teaching for medical students during COVID-19: measuring effectiveness and satisfaction. *BMC Med. Educ., 21(1)*:452, 2021.

Antonoff, M. B.; Verrier, E. D.; Yang, S. C.; Lin, J.; DeArmond, D. T.; Allen, M. S.; Varghese Jr., T. K.; Sengewald, D. & Vaporciyan, A. A. Online learning in thoracic surgical training: promising results of multi-institutional pilot study. *Ann. Thorac. Surg., 98(3)*:1057-63, 2014.

Arbour, M. W.; Nypaver, C. F. & Wika, J. C. Innovative uses of technology in online midwifery education. *J. Midwifery Womens Health, 60(3)*:278-82, 2015.

Aristeidou, M. & Cross, S. Disrupted distance learning: the impact of Covid-19 on study habits of distance learning university students. *Open Learn., 36(3)*:263-82, 2021.

Barbeau, M. L.; Johnson, M.; Gibson, C. & Rogers, K. A. The development and assessment of an online microscopic anatomy laboratory course. *Anat. Sci. Educ., 6(4)*:246-56, 2013.

Bell, B. S. & Federman, J. E. E-Learning in postsecondary education. *Future Child, 23(1)*:165-85, 2013.

Bentler, P. M. Comparative fit indexes in structural models. *Psychol. Bull., 107(2)*:238-46, 1990.

Darici, D.; Reissner, C.; Brockhaus, J. & Missler, M. Implementation of a fully digital histology course in the anatomical teaching curriculum during COVID-19 pandemic. *Ann. Anat., 236*:151718, 2021.

Dixson, M. D. Measuring student engagement in the online course: The online student engagement scale (OSE). *Online Learn, 19*, 2015.

Dziuban, C. D. & Shirkey, E. C. When is a correlation matrix appropriate for factor analysis? Some decision rules. *Psychol. Bull., 81(6)*:358-61, 1974.

Evans, D. J. R.; Bay, B. H.; Wilson, T. D.; Smith, C. F.; Lachman, N. & Pawlina, W. Going virtual to support anatomy education: A STOPGAP in the midst of the Covid-19 pandemic. *Anat. Sci. Educ., 13(3)*:279-83, 2020.

Fabrigar, L. R.; Wegener, D. T.; MacCallum, R. C. & Strahan, E. J. Evaluating the use of exploratory factor analysis in psychological research. *Psychol. Methods, 4*:272, 1999.

Farrell, O. & Brunton, J. A balancing act: a window into online student engagement experiences. *Int. J. Educ. Technol. High. Educ., 17*:5, 2020.

Godoy-Guzman, C.; Osses, M.; San Martin, S.; Leiva, G. & Jara-Rosales, S. MOODLE lesson of the anatomy and histology of the human placenta. *Int. J. Morphol., 37(1)*:178-83, 2019.

Gwet, K. L. *Handbook of Inter-Rater Reliability. The Definitive Guide to Measuring the Extent of Agreement Among Raters*. Gaithersburg, Advanced Analytics, 2001. Available from: https://www.agreestat.com/book4/9780970806284_prelim_chapter1.pdf

Hameed, T.; Husain, M.; Jain, S. K.; Singh, C. B. & Khan, S. Online medical teaching in COVID-19 era: experience and perception of undergraduate students. *Maedica (Bucur), 15(4)*:440-4, 2020.

Hwang, S. Y. & Kim, M. J. A comparison of problem-based learning and lecture-based learning in an adult health nursing course. *Nurs Educ. Today, 26(4)*:315-21, 2006.

Ibrahim, N. K.; Al Raddadi, R.; AlDarmasi, M.; Al Ghamdi, A.; Gaddoury, M.; AlBar, H. M. & Ramadan, I. K. Medical students' acceptance and perceptions of e-learning during the Covid-19 closure time in King Abdulaziz University, Jeddah. *J. Infect. Public Health, 14(1)*:17-23, 2021.

Jara-Rosales, S.; Pérez-Pérez, C.; Godoy-Guzmán, C.; Fernández, J. & Sepúlveda-Gotterbarm J. Percepción de estudiantes de tercer año de la carrera de obstetricia sobre el escenario simulado "eritroféresis neonatal". *Rev. Matronería Actual (1)*:17-26, 2020.

Jara-Rosales, S.; Pérez, C.; Sepúlveda, J.; Paredes, D.; Fernández, J. & Godoy-Guzmán, C. Instagram como herramienta didáctica de apoyo a la asignatura Neonatología en modalidad online en el contexto de la pandemia por COVID-19. *Rev. Educ. Cienc. Salud, 19(2)*:74-7, 2022.

Jayakumar, N.; Brunckhorst, O.; Dasgupta, P.; Khan, M. S. & Ahmed, K. e-Learning in surgical education: a systematic review. *J. Surg. Educ., 72(6)*:1145-57, 2015.

Lavender, T.; Omoni, G.; Lee, K.; Wakasiaki, S.; Campbell, M.; Watiti, J. & Mathai, M. A pilot quasi-experimental study to determine the feasibility of implementing a partograph e-learning tool for student midwife training in Nairobi. *Midwifery, 29(8)*:876-84, 2013.

McVeigh, H. Factors influencing the utilisation of e-learning in post-registration nursing students. *Nurse Educ. Today, 29(1)*:91-9, 2009.

Moule, P.; Ward, R. & Lockyer, L. Nursing and healthcare students' experiences and use of e-learning in higher education. *J. Adv. Nurs., 66(12)*:2785-95, 2010.

Pather, N.; Blyth, P.; Chapman, J. A.; Dayal, M. R.; Flack, N.; Fogg, Q. A.; Green, R. A.; Hulme, A. K.; Johnson, I. P.; Meyer, A. J.; *et al*. Forced disruption of anatomy education in Australia and New Zealand: an acute response to the Covid-19 pandemic. *Anat. Sci. Educ., 13(3)*:284-300, 2020.

Prasad, N.; Fernando, S.; Willey, S.; Davey, K.; Kent, F.; Malhotra, A. & Kumar, A. Online interprofessional simulation for undergraduate health professional students during the COVID-19 pandemic. *J. Interprof. Care, 34(5)*:706-10, 2020.

Rovai A. P. & Barnum, K. T. On-line course effectiveness: An analysis of student interactions and perceptions of learning. *Int. J. E-learn. Distance Educ., 18*:57-73, 2007.

Schunk, D. H.; Pintrich, P. R. & Meece, J. L. *Motivation in Education*. 3rd ed. Upper Saddle River, Pearson Merrill Prentice Hall, 2008.

Srinivasan, D. K. Medical students' perceptions and an anatomy teacher's personal experience using an e-learning platform for tutorials during the Covid-19 crisis. *Anat. Sci. Educ., 13(3)*:318-9, 2020.

Stetson, G. V.; Kryzhanovskaya, I. V.; Lomen-Hoerth, C. & Hauer, K. E. Professional identity formation in disorienting times. *Med. Educ., 54(8)*:765-6, 2020.

Stoehr, F.; Müller, L.; Brady, A.; Trilla, A.; Mähringer-Kunz, A.; Hahn, F.; Düber, C.; Becker, N.; Wörns, M. A.; Chapiro, J.; *et al*. How COVID-19 kick-started online learning in medical education-The DigiMed study. *PloS One, 16(9)*:e0257394, 2021.

Toledo-Ordoñez, I.; Onetto, N.; Concha, M.; Sanhueza, S.; Osses, M.; Padilla-Meza, J. & Godoy-Guzmán, C. Design and manufacturing of 3D printed models as a complement for medical histology practical class. *Int. J. Morphol., 40(2)*:355-9, 2022.

Wilhelm, J.; Mattingly, S. & Gonzalez, V. H. Perceptions, satisfactions, and performance of undergraduate students during Covid-19 emergency remote teaching. *Anat. Sci. Educ., 15(1)*:42-56, 2022.

Zhao, P.; Sintonen, S. & Kynäslahti, H. The pedagogical functions of arts and cultural-heritage education with in online art galleries and musuems. *Int. J. Herit. Digit. Era, 4(1)*:103-20, 2015.

Corresponding author:
Prof. Dr. Carlos Godoy-Guzmán
Escuela de Medicina
Universidad de Santiago de Chile
Avda. Bdo. O'Higgins 3363
Correo 442
Santiago
CHILE

E-mail: carlos.godoy@usach.cl