

Analysis of Learning Acquired through Peer Tutoring in the Training of Physical Examination Skills in Clinical Simulation in Medical Students

Análisis del Aprendizaje Adquirido, a través de la Tutoría entre Pares, en la Formación de Habilidades de Exploración Física en Simulación Clínica en Estudiantes de Medicina

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Summary: Introduction. Peer tutoring refers to when a student from an upper grade teaches a student from a lower grade. The aim of this work is to evaluate the competence in physical examination acquired by medical students through peer tutoring, and to determine the students' satisfaction with this form of teaching in their clinical training. **Material and Methods.** An observational and cross-sectional pilot study of physical examination workshops conducted by a student tutor using the peer tutoring methodology was carried out. **Results.** Six physical examination workshops were conducted, distributed in 72 sessions, with the participation of 85 students, of which 50.6% were in their third year and 49.4% in their second year. Each student attended, on average, 2.5 sessions, with a range of 1 to 8 attendances. A significant improvement in knowledge was observed pre and post workshop in the six workshops (mean: 2.4 points, $p < 0.001$), with this improvement being greater in the pulmonary auscultation workshop (mean: 3.6 points; $p < 0.001$) and in the neurological examination workshop (mean: 2.9 points; $p < 0.001$). The improvement in acquired knowledge was greater in second year students (mean: 2.8 points) compared to third year students (mean: 2.2 points; $p < 0.001$). Student satisfaction with the workshops was high. **Conclusions.** Peer tutoring is a learning method that allows improving physical examination skills in medical students.

Keywords: peer tutoring, clinical simulation, clinical skills, educational methodology, student satisfaction.

Resumen: Introducción. La tutoría entre pares se refiere a cuando un estudiante de un curso superior enseña a un estudiante de un curso inferior. El objetivo de este trabajo es evaluar la competencia en exploración física adquirida por los estudiantes de medicina a través de la tutoría entre pares, y determinar la satisfacción de los estudiantes con esta forma de enseñanza en su formación clínica. **Material y Métodos.** Se realizó un estudio piloto observacional y transversal de talleres de exploración física llevados a cabo por un estudiante-tutor utilizando la metodología de tutoría entre pares. **Resultados.** Se llevaron a cabo seis talleres de exploración física, distribuidos en 72 sesiones, con la participación de 85 estudiantes, de los cuales el 50,6% pertenecía a tercer año y el 49,4% a segundo año. Cada estudiante asistió, en promedio, a 2,5 sesiones, con un rango de 1 a 8 asistencias. Se observó una mejora significativa en el conocimiento pre y post taller en los seis talleres (media: 2,4 puntos, $p < 0,001$), siendo esta mejora mayor en el taller de auscultación pulmonar (media: 3,6 puntos; $p < 0,001$) y en el de exploración neurológica (media: 2,9 puntos; $p < 0,001$). La mejora del conocimiento adquirido fue superior en los estudiantes de segundo año (media: 2,8 puntos) en comparación con los de tercer año (media: 2,2 puntos; $p < 0,001$). La satisfacción de los estudiantes con los talleres fue elevada. **Conclusiones.** La tutorización entre pares es un método de aprendizaje que permite mejorar las habilidades en la exploración física en estudiantes del grado en medicina.

Palabras clave: tutoría entre pares, simulación clínica, habilidades clínicas, metodología educativa, satisfacción del estudiante.

1. Introduction

Peer tutoring, also known as "buddy tutoring," involves an upperclassman tutoring a lowerclassman¹. This allows the more advanced student to share his or her knowledge and experience with his or her less experienced peers. Peer tutoring is a way of teaching students how to learn and how to use their skills. Peer-to-peer support is an effective form of academic support that fosters a collaborative learning environment. This educational methodology is used in medical schools at Spanish-speaking universities in Latin America (1-4).

The student who takes on the role of tutor is usually in the fourth or fifth year of Medicine and his objective is to help his students improve their knowledge, guide them and resolve their doubts as far as possible (1). This experience also benefits the tutor, as it allows him to develop better communication skills, become familiar with teaching, increase his professional confidence and reinforce his previous knowledge (3-4). The tutor, in turn, is supervised, accompanied and guided by a professor, who is responsible for resolving doubts and problematic situations that may arise.

On the other hand, tutored students improve their academic performance and gain greater confidence, reducing the stress associated with studying. Their commitment and willingness are important to optimize this educational methodology (1-4).

Clinical simulation is an educational technique used for learning clinical skills (5-6). Through simulation, real clinical situations and skills are recreated, allowing students to practice in a safe environment without putting patients at risk. This technique helps students gain confidence and experience, facilitating the application of theory to practice and allowing mistakes to be made without serious consequences.

The Department of Clinical Medicine at the Faculty of Medicine of the Miguel Hernández University (UMH) has implemented peer tutoring in the area of clinical simulation at the UMH (ASCUMH). A fourth-year student of the degree in Medicine has tutored second- and third-year students in the acquisition of physical examination skills. The objective of this work is to evaluate some aspects of physical examination acquired by medical students through peer tutoring, and to determine the satisfaction of students with this form of teaching in their clinical training.

2. Methods

2.1. *Type of study, location and study population*

This is a prospective, observational, cross-sectional study conducted at the ASCUMH of the Faculty of Medicine. The ASCUMH is equipped with low and medium fidelity simulators and has technical support staff to perform clinical simulations for medical students. The UMH Faculty of Medicine is located on the Sant Joan d'Alacant Campus (Alicante) and enrolls 124 students each year.

2.2. *Study population*

The study population included 132 students enrolled in the second-year General Pathology course and 108 students in Integrated Workshops 2 in the third year, who were offered to participate in the workshops on a voluntary basis. As practical training for the course, the General Pathology students did 5 exploration workshops in groups of 25 people for a total of 7 hours and hospital practical training in internal medicine for an introduction to clinical practice for 5 days for a total of 20 hours. And the Integrated Workshops students did hospital clinical practical training for 8 days for a total of 36 hours.

2.3. *Intervention carried out - exploration workshop with peer tutoring.*

A fourth-year student was selected through the UMH Training and Research Program (PAFI). The student-tutor taught three physical examination workshop sessions at ASCUMH for two days a

week. Each workshop lasted one hour and had a maximum of five students per session, allowing for a maximum of 15 students per day and 30 students per week. Six different workshops were taught, changing the content weekly until a six-week cycle was completed. Subsequently, another six-week cycle was completed. The workshops conducted were as follows:

1. Cardiac auscultation: the different auscultation foci were reviewed and the identification of normal and abnormal cardiac sounds was practiced by auscultation of simulation torsos.
2. Pulmonary auscultation: the subject studied how to perform anterior and posterior auscultation of the thorax and practiced identifying normal and abnormal lung sounds by auscultating simulated torsos.
3. Abdominal examination: the abdominal regions were reviewed, as well as the anatomical arrangement of the abdominal organs. Abdominal examination was practiced among the students (auscultation, superficial and deep examination, percussion). Normal and abnormal abdominal auscultation sounds were performed using simulators. In addition, renal fist percussion was practiced.
4. Examination of the rectum and breasts:
 1. During the rectal examination, they reviewed the clinical situations in which it should be used and how it is performed. In addition, they practiced using two digital rectal examination simulators. First, they were able to practice abnormalities in the rectum and, in the second, prostate pathology.
 2. During the breast examination, the warning criteria for breast cancer were reviewed, as well as when to perform a breast examination and how to examine the breasts, armpits and supraclavicular lymph node regions. Two simulators were used, one of which showed probable signs of breast neoplasia and the other simulator showed benign nodules.
5. Neurological examination: cranial nerve examination, reflex examination, sensitivity and strength examination, gait and balance examination, meningeal syndrome, Weber and Rinne test and fundus examination were performed. Lumbar puncture was also performed using a simulator.
6. Skills: Students were able to practice taking blood pressure, heart rate and respiratory rate and using pulse oximeters. Next, an explanation was given of how to perform an electrocardiogram, and students were able to perform an electrocardiogram on a classmate. Students were able to see how an electrocardiogram is performed on the virtual campus.

Students had available supplementary material that they had to review before the workshop. The student-tutor was in charge of preparing the supplementary material prior to the workshop on the virtual campus (in the simuloteca [organized collection of resources and materials designed for clinical simulation]), under the supervision of the professor in charge and the ASCUMH technical team.

2.4. Evaluation of the intervention carried out

In each workshop, prior and acquired knowledge was assessed using a Google Form (multiple choice test before and after the workshop). The maximum score for the knowledge test before and after was 10. At the end, a satisfaction survey was administered consisting of 10 questions with answers on a Likert scale (1: strongly disagree, 5: strongly agree).

2.5. Statistical analysis

Results were collected in a Google form and analyzed using IBM SPSS for Windows (version 25.0; IBM Corp., Armonk, NY, USA). Continuous variables were expressed as mean (\bar{x}) and standard deviation (SD), or median and interquartile range (IQR), depending on the distribution of the variable. Pre- and post-workshop analysis was evaluated with the Student t test for paired samples and with ANOVA when there were more than three categories. Knowledge improvement and degree of satisfaction were analyzed by sex, academic year, and workshop. Statistical significance was considered when the p value was less than 0.05.

2.6. Ethical aspects

The study was approved by the Ethics and Integrity Committee in Research at the Miguel Hernández University of Elche (TFG.GME.JMRR.MLB.241029). The students gave their consent online in the satisfaction survey form, to participate in the project and complete the questionnaires before and after the workshop, as well as the satisfaction survey.

3. Results

3.1. Attendance at the exploration workshop with peer tutoring

Five places were offered per workshop, with each workshop being held over 4 days, with 3 sessions per day, allowing for a total capacity of 360 attendees. Of these, 207 people attended, representing an occupancy rate of 57.5%. Table 1 shows the occupancy rate for the physical examination workshop. The workshop with the highest attendance was the neurological examination workshop (73.3%), while the pulmonary examination workshop had the lowest attendance (41.7%).

Table 1. Attendance and occupancy rate of the peer-tutored exploration workshop.

Workshop	Number of attendants	Number of places	Occupancy rate (%)
Cardiac auscultation	27	60	45
Pulmonary auscultation	25	60	41.6
Abdominal examination	39	60	65
Rectal and breast examination	38	60	63.3
Neurological examination	44	60	73.3
Skills	34	60	56.6
Total	207	360	57.5

3.2. Characteristics of students who attended the peer-tutored exploration workshop

There were 85 students in attendance: 50.6% from the third year and 49.4% from the second year. Of these, 43.5% were male and 56.5% female. The average attendance per student was 3.0, with a range of 1 to 8 attendances. There were no differences in the median or mean attendance according to sex or academic year (Table 2).

Table 2. Characteristics of students who attended and number of attendees at the peer-tutored exploration workshop

	Students	Attendance		P value	Minimum and Maximum
	N (%)	Media (SD)	Median (IQR)		
Total	85	3.0 (2,1)	2.0 (1.0-5.0)		1 and 8
Sex				0.329*	
Man	37 (43.5)	2.7 (2.1)	2.0 (1.0-5.0)		1 and 8
Women	48 (56.5)	3.2 (2.2)	3.0 (1.0-5.0)		1 and 7
Course				0.912*	
Second	43 (50.6)	3.0 (2.0)	2 (1.0-5.0)		1 and 8
Third	42 (49.2)	3.0 (2.3)	1.5 (1.0-5.0)		1 and 6

Abbreviation: N: number, %: percentage, SD: standard deviation, IQR: interquartile range

*Nonparametric U-Mann Whitney test.

3.3. Learning after the peer-tutored exploration workshop

Of the 207 registered attendances, 11 students did not complete the survey correctly, so 196 pre- and post-peer-tutored exploration workshop assessment exercises were analyzed. The degree of knowledge before the workshop was lower in second-year students compared to third-year students (\bar{x} : 5.8 vs. 6.8 points; $p=0.004$) (see table 3).

There was a significant improvement in pre- and post-workshop knowledge in all six workshops (\bar{x} : 2.4 points; $p<0.001$), especially in the pulmonary auscultation workshop (\bar{x} : 3.6 points; $p<0.001$) and neurological examination (\bar{x} : 2.9 points; $p<0.001$). The improvement in acquired knowledge was greater in second-year students (\bar{x} : 2.8 points) compared to third-year students (\bar{x} : 2.2 points) ($p<0.001$), with no differences by gender of the students (see table 3).

3.4. Peer-tutored exploration workshop satisfaction survey

Students were given a survey after each workshop consisting of 9 questions with a rating range from 0 to 5 (Likert scale). The average rating for each item is in Table 4; for all items the average rating was higher than 4. When analyzing the different satisfaction items by sex, we found that female students rated the student-tutor more highly than male students (\bar{x} : 4.98 vs 4.91; $p=0.021$). And that second-year students rated the usefulness of the audiovisual content of the simulation library for the exploration workshop more highly than third-year students (\bar{x} : 4.89 vs 4.69; $p=0.007$).

4. Discussion

Sharing experiences in clinical simulation probably generates information and enrichment for other teachers and students (5). For this reason, we have been motivated to present this research that combines learning physical examination in a simulated environment and peer tutoring, which we will discuss below.

Peer tutoring is an organizational modality and a pedagogical strategy in which students, generally from higher courses, accompany their peers in the orientation and reinforcement of learning processes within a disciplinary area. In our study, peer tutoring has allowed good student performance, with high student satisfaction. This may be favored by the fact that the student-tutor is more in tune with his peers, which facilitates greater support in the self-learning process (7).

The student-tutor has received permanent support throughout the clinical simulation process from the teachers in charge, to resolve doubts or solve possible problematic situations that could arise with a student. For the student-tutor, it is also an enriching experience from the point of view of the

formation of values, which strengthen their future personal and professional life. In studies carried out in the USA (8-10), this experience of the student-tutor has been reflected in a better score in subsequent exams such as the ECOE test (objective and structured clinical evaluation (8), as well as the student who has received tutoring by another student in the field of semiology (9-10).

Given the large number of schools or faculties that develop clinical simulation, we consider it relevant to implement an effective training program that includes the students themselves as facilitators, which can be an essential element in the success of any educational innovation, as presented in this experience (7-11).

Table 3. Degree of knowledge of exploratory skills before and after the peer-tutored exploration workshop.

	Before Mean (SD) Median (IQR)	P value	After Mean (SD) Median (IQR)	P value	Improvement Mean (SD)	P value
Total	6.4 (2.6) 6.7 (5-8.3)		8.8 (1.6) 10 (8-10)		2.4 (2.1)	<0.001 ‡
Workshop		<0.001*		<0.001*		
Cardiac auscultation	7.3 (3.1) 8.3 (5.0-10.0)		9.4 (1.5) 10(10-10)		2.8 (0.5)	<0.001 ‡
Pulmonary auscultation	3.8 (2.0) 3.1 (2.4-5.5)		7.1 (6.2-9.0) 7.3 (2.1)		3.6 (2.2)	<0.001 ‡
Abdominal examination	6.2 (2.3) 6.0 (4.0-8.0)		8.5 (1.8) 8.0 (6.2-9.0)		2.3 (2.0)	<0.001 ‡
Rectal and breast examination	7.1 (2.3) 7.5 (5.0-8.3)		8.9 (1.2) 8.3 (8.3-10)		1.8 (1.8)	<0.001 ‡
Neurological examination	6.1 (2.6) 6.7 (3.3-8.3)		9.0 (1.4) 10 (7,5-10)		2.9 (1.9)	<0.001 ‡
Skills	7.6 (1.6) 7.5 (6.7-8.3)		9.4 (1.0) 10 (9,3-10)		1.9 (1.4)	<0.001 ‡
Sex		0.813**		0.385**		
Man	6.4 (2.6) 6.7 (4.2-8.3)		8.9 (1.6) 10 (8,1-10)		2.5 (2.1)	<0.001 ‡
Woman	6.3 (2.6) 6.7 (5.0-8.3)		8.7 (1.6) 10 (8.0-10)		2.4 (2.1)	<0.001 ‡
Course		0.004**		0.385**		
Second	5.8 (2.8) 6.0 (3.3-8.3)		8.5 (1.9) 9.0 (8.9-10)		2.8 (2.4)	<0.001 ‡
Third	6.8 (2.4) 6.7 (5-8.3)		8.9 (1.4) 10 (8,1-10)		2.2 (1.8)	<0.001 ‡

Abbreviation: %: percentage, SD: standard deviation, IQR: interquartile range. P value of the degree of knowledge before and after the workshop was calculated using the nonparametric Kruskal Wallis test* and the Mann-Whitney U test**. The p value of the improvement in knowledge before and after the repeated samples Student T-test‡

Table 4. Evaluation of the peer-tutored exploration workshop.

Valued item	Mean (SD)	Median (IQR)
Do you feel that your learning has improved after attending the self-study classroom?	4.8 (0.5)	5 (5-5)
Has the workshop met your initial expectations?	4.8 (0.4)	5 (5-5)
Rate the usefulness of the audiovisual content of the simulation library for learning clinical skills.	4.8 (0.5)	5 (5-5)
How would you rate the usefulness of this training method for your academic development?	4.9 (0.4)	5 (5-5)
How do you rate the workshop booking system in relation to planning your visit?	4.7 (0.7)	5 (5-5)
How do you rate the suitability of the accommodation for the workshop?	4.8 (0.4)	5 (5-5)
Did the facilities and resources available facilitate learning?	4.8 (0.5)	5 (5-5)
Did the simulators used meet the requirements for effective training?	4.6 (0.7)	5 (5-5)
Did the student facilitator contribute positively to your learning experience?	4.9 (0.2)	5 (5-5)

In addition, we are increasing the number of students with a stabilization of the teaching staff in the Faculties of Medicine, which makes peer tutoring an attractive option for them (12). And as it has been collected in the literature with benefits for the student-tutor as well as the student who learns. And this student-tutor as it has been presented in this experience can be an alternative for learning in the area of clinical simulation as it is collected in other studies (13).

We would like to discuss the results of the intervention in the physical examination workshop with peer tutoring in the simulation area. Firstly, we would like to highlight the good reception of this innovative activity, which was attended by half of the students of the two subjects involved. It is worth mentioning that it was a voluntary activity, with no impact on the subject grade, which reflects the interest of the students in improving their skills in physical examination, an aspect of clinical history that is more difficult to delve into in a setting with real patients. The simulation environment allows these skills to be practiced without the risk of making mistakes, and enables the repetition of the procedures using mannequins and skills trainers (14) such as those used in our workshop.

Students showed particular interest in the neurological examination workshop, which is understandable, given that this examination is not covered in depth during clinical practice in the first years. In our study, as expected, the degree of knowledge acquired after the simulation was higher in second-year students compared to third-year students, since the former have fewer hours of clinical practice. The two workshops in which the greatest difference in pre- and post-intervention scores was obtained were the pulmonary auscultation and the neurological examination workshops.

Among the limitations, first, the number of students who participated was limited. Second, the knowledge assessment test consisted of multiple choice questions with four answers ranging from 5 to 11 depending on the workshop to be held, which is subject to the subjectivity of the questions. Third, the workshop satisfaction questionnaire was specifically designed for this workshop and a validated clinical simulation quality and satisfaction questionnaire was not used, with three dimensions (learning of technical skills; structure of the simulation session; communication and student motivation in clinical simulation) (15-16). The research team intends to validate and pilot the surveys for better performance in future research.

5. Conclusions

- Despite the limitations of the study, the peer-tutored exploration workshop conducted in the simulation area has improved the physical examination skills of second and third year medical students, with good satisfaction from them.

- Learning physical examination in a simulated environment allows the student to acquire skills and confidence to then perform it in a real environment with a patient.
- We recommend this experience for other medical schools to implement the practice of physical examination in a simulated environment and incorporate peer mentoring, as has been done in our school.

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