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UNIVERSITÉ CADI AYYAD

Année 2022 Thèse N° 091

Evaluation of a training program on clinical reasoning using a serious game

THÈSE

PRÉSENTÉE ET SOUTENUE PUBLIQUEMENT LE 04/04/2022

PAR

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Née le 21 Octobre 1995 à Marrakech

POUR L'OBTENTION DU DOCTORAT EN MEDECINE

MOTS-CLÉS :

Medical students – Clinical reasoning – Serious games – Virtual patients

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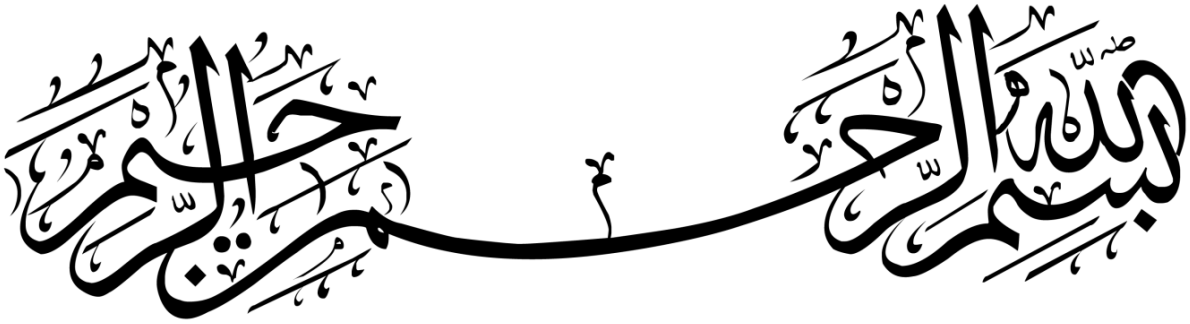

"رَبِّ أَوْزِعْنِي أَنْ أَشْكُرَ نِعْمَتَكَ الَّتِي أَنْعَمْتَ عَلَيَّ وَعَلَى وَالِدَيَّ وَأَنْ أَعْمَلَ صَالِحاً تَرْضَاهُ وَ أَدْخِلْنِي بِرَحْمَتِكَ فِي عِبَادِكَ الصَّالِحِينَ".

صدق الله العظيم

سورة النمل

الآية 19

Serment d'Hippocrate

Au moment d'être admis à devenir membre de la profession médicale, je m'engage solennellement à consacrer ma vie au service de l'humanité.

Je traiterai mes maîtres avec le respect et la reconnaissance qui leur sont dus.

Jepratiquerai ma profession avec conscience et dignité. La santé de mes malades sera mon premier but.

Jene trahirai pas les secrets qui me seront confiés.

Je maintiendrai par tous les moyens en mon pouvoir l'honneur et les nobles traditions de la profession médicale.

Les médecins seront mes frères.

Aucune considération de religion, de nationalité, de race, aucune considération politique et sociale, ne s'interposera entre mon devoir et mon patient.

Je maintiendrai strictement le respect de la vie humaine dès sa conception.

Même sous la menace, je n'userai pas mes connaissances médicales d'une façon contraire aux lois de l'humanité.

Je m'y engage librement et sur mon honneur.

Déclaration Genève, 1948

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DEDICACES

A mes parents,

Loubaba Berrissoule et Abderrahim Fouali,

merci pour tout ce que vous avez fait pour moi. Il n'y aura jamais suffisamment de mots pour vous exprimer ma gratitude. Je vous aime très fort.

Et enfin je tiens à remercier toute ma famille et mes amis qui m'ont soutenue, tous les professeurs qui m'ont enseignée, et les patients qui m'on fait confiance. Je ne serais pas la personne que je suis aujourd'hui sans la présence de chacun et chacune d'entre vous.

REMERCIEMENTS

Au Président du jury, Professeur A.R. El ADIB,

merci de m'avoir fait confiance et de m'avoir donné l'opportunité de travailler sur ce sujet fascinant. Ce fut un honneur de travailler avec vous , que ce soit au service ou pendant la réalisation de cette thèse. Et merci de m'honorer en présidant cette thèse qui n'aurait pas eu lieu sans vous.

A mon Rapporteur, Professeur A. HACHIMI,

merci pour votre patience, pour vos encouragements, et pour tout ce que vous m'avez appris. Je suis honorée d'avoir pu travailler avec vous. Je chérirai ces lessons toute ma vie.

Au Professeur M. SEBBANI,

merci pour votre patience et votre aide lors de la réalisation de cette thèse , et merci pour tout ce que vous m'avez appris. Je suis honorée de pouvoir préenter cette thèse en votre présence.

Au Professeur H. Rebahi,

merci pour tout ce que vous m'avez appris au service, et merci de me faire l'honneur de votre présence lors de ma soutenance. Ce fut un honneur de vous connaître, et de travailler avec vous.

PLAN

INTRODUCTION

During the last decades, medical teaching has experienced many changes at an ever-increasing pace and will continue to do so [1]. Teachers and students alike are constantly looking for new knowledge acquiring methods, to increase both motivation and effectiveness. And with the rise of technology, the methodologies have gotten more and more creative [2].

Active learning techniques, including gamification, are becoming increasingly prevalent in medical education [3]. It allows students to acquire and test their knowledge in a safe controlled environment, where no patient is harmed during the high-risk stressful learning phase. Besides, they will repeat their training experience until the learning goal is achieved [4].

The COVID-19 pandemic has also shown the importance of virtual learning and how prevalent it might become in the coming years. Game-based learning is still a relatively new subject, with plenty of room for improvement and high demand in the current context [5].

Virtual Patient Simulators (VPS) are intuitive computer-based patient cases. They are available in many settings, in which there is computer access. In the beginning, a brief patient report is given, and the learner works on a diagnosis or a treatment plan [6].

Body Interact™ (BI) is a newly developed VPS in this context. It is an online game that aims to improve critical thinking, decision-making, and clinical reasoning in medical students and healthcare professionals [7].

It can be used individually or in groups and includes several clinical cases in different specialties such as cardiology, endocrinology, gastroenterology, obstetrics, paediatrics, and trauma. BI VPS is simple to use and well-accepted by students [8-11].

We aimed to assess the participants' perceptions of the Virtual Patient Simulator.

METHODOLOGY

I. Nature of study:

This was a quasi-experimental observational study, as part of an international study conducted in 11 universities across the world (4 in Portugal, 1 in Canada, 1 in Honduras, 1 in Pologna, 1 in Norway, 1 in Georgia, 1 in China, and 1 in our university in Morocco) aiming to assess the perceived impact of BI VPS amongst medical students and nurses. The studies all followed the same methodology.

II. Participants and inclusion criteria:

All volunteer medical students from 3rd year to 7th year.

III. Exclusion criteria:

Students who have already tried and used a Virtual Patient Simulator were excluded.

IV. Ethical considerations:

All answers were confidential, and students' anonymity was respected, with conformation to ethical considerations.

V. The study period:

FromFebruary 1st to March 31st, 2020.

VI. Body interact™ platform and training sessions:

1. Available specialties:

Allergy/Immunology, Cardiology, Endocrinology, Family Medicine, Gastroenterology, General Surgery, Infectious Diseases, Intensive Care, Internal Medicine, Nephrology, Neurology, Obstetrics, Oncology, Orthopaedic, Otorhinolaryngology, Paediatrics, Pregnancy/Gynaecology, Physiotherapy, Pulmonology, Respiratory, Toxicology, Trauma, Urology, Vascular Surgery, Wound care.

2. Briefing:

The time for each scenario can be adjusted from 5 to 30 minutes. Each scenario starts with a briefing. The student reads and hears a brief description of the patient's clinical history.

3. Dialogues:

The student can ask questions on different topics; answers change depending on the patient's condition. Virtual Patients maybe aware, confused, agitated, or unconscious.

Figure 1: Example of a dialogue with a virtual patient

4. Physical examination:

The student can perform a complete ABCDE assessment: Airway observation, Breathing, Circulation, Disability, Exposure.

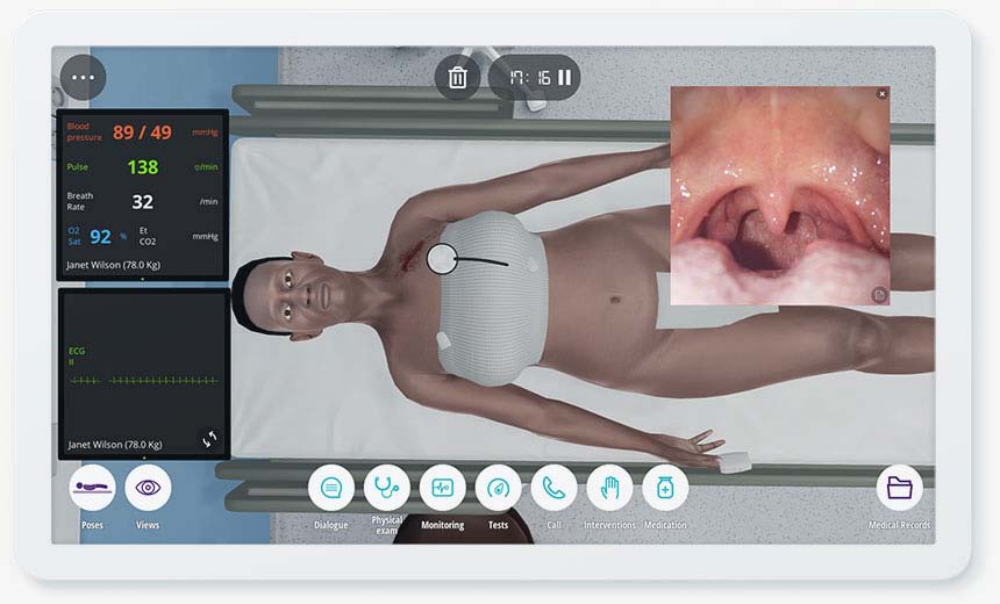

Figure 2: Example of a physical assessment on a virtual patient

5. Monitoring:

With the real-time vital parameters monitor, the student can observe the virtual patient's vital signs and recognize and act accordingly if or when the patient's condition worsens.

Figure 3: Example of a monitoring scope chart of a virtual patient

6. Request Exams:

The student may order further examination that helps them make the diagnosis and define the treatment plan: lab tests, electrophysiology, imaging, and decision aids.

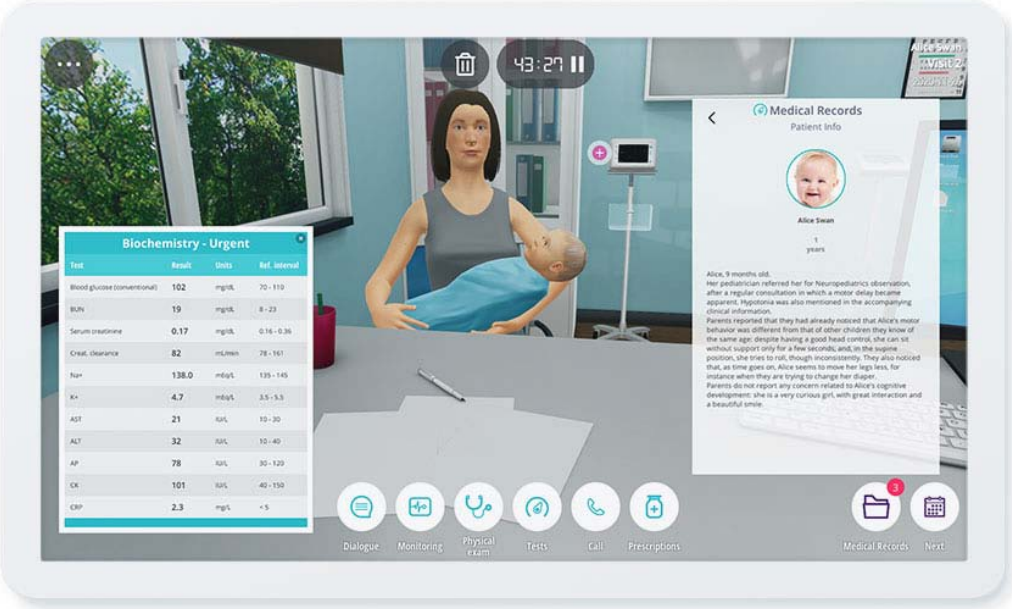

Figure 5: Example of biological exams results of a virtual patient

Figure 6: Example of electrophysiology exam results of a virtual patient

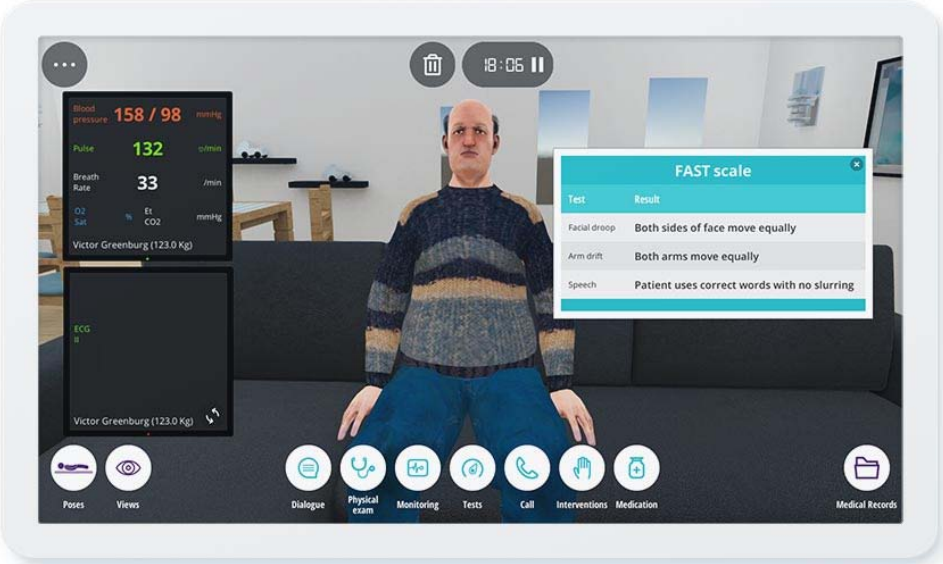

Figure 7: Example of Exam results of a virtual patient

7. Call a specialist:

When calling a specialist or other medical staff, the student can ask for advice, perform a specific intervention, or obtain authorization for a procedure.

Figure 8: Example of a specialist's assessment of a virtual patient

8. Intervention:

There are plenty of intervention options that can be applied, from catheters or defibrillation to chest compressions, oxygen, or transfusion. The student may also change the patient's position.

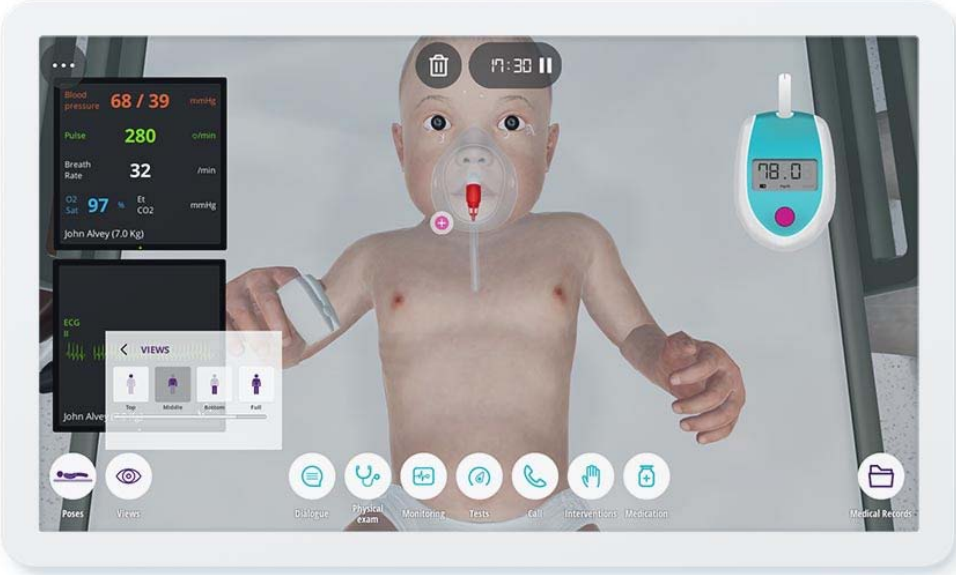

Figure 9: Example of an intervention on a virtual patient

9. Administering medication:

A complete set of drugs and fluids are available to select by category, administration mode, and doses. Any given medication has real-time effects on the virtual patient and will change their health conditions. In basic scenarii, treatments are only available by categories; specific drugs and dosages are not required.

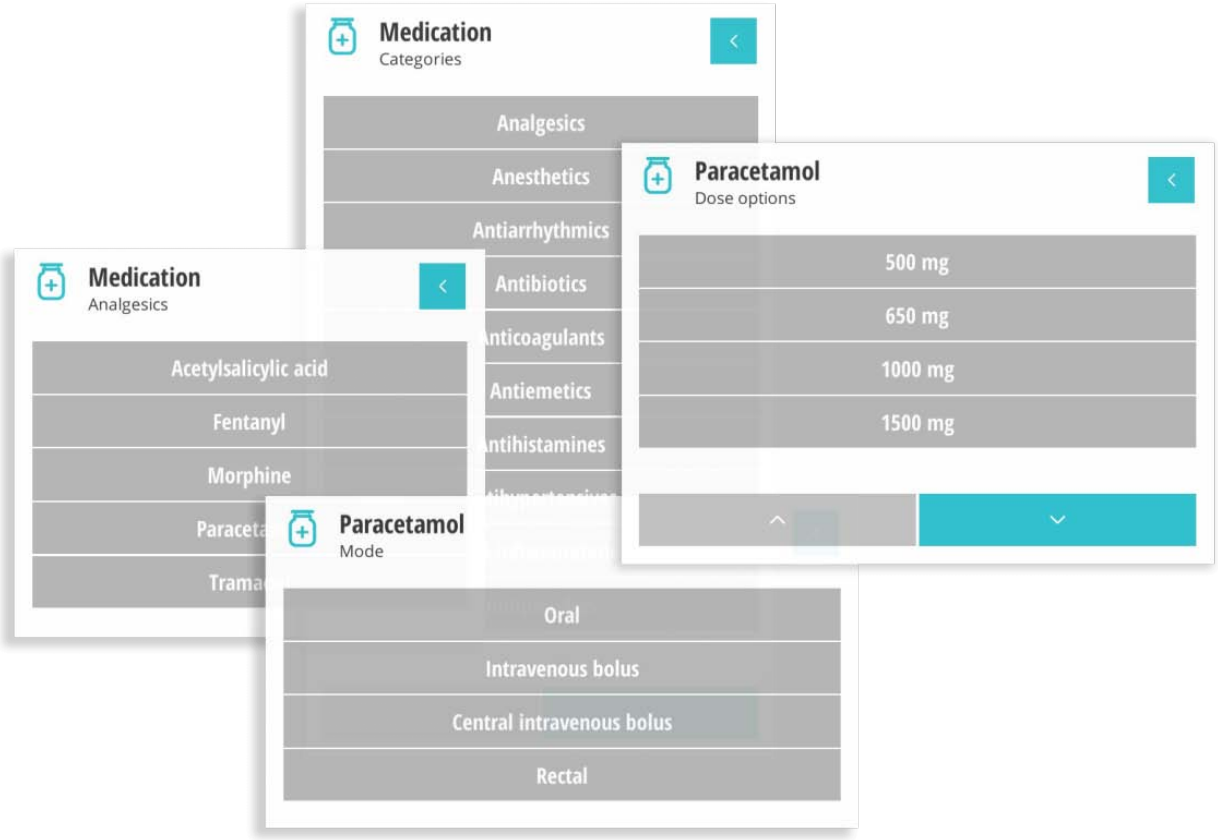

Figure 10: Example of medication prescription on the Virtual Patient Simulator

10. Feedback:

Once the scenario is completed, the students receive feedback to understand how well they treated their virtual patient throughout the clinical procedure and what to improve. According to well-established guidelines, they can analyze their actions in detail and their impact on the patient's vital signs, review how they performed in physical examination, diagnosis, and treatment, and check the clinical competencies they applied while treating their patient.

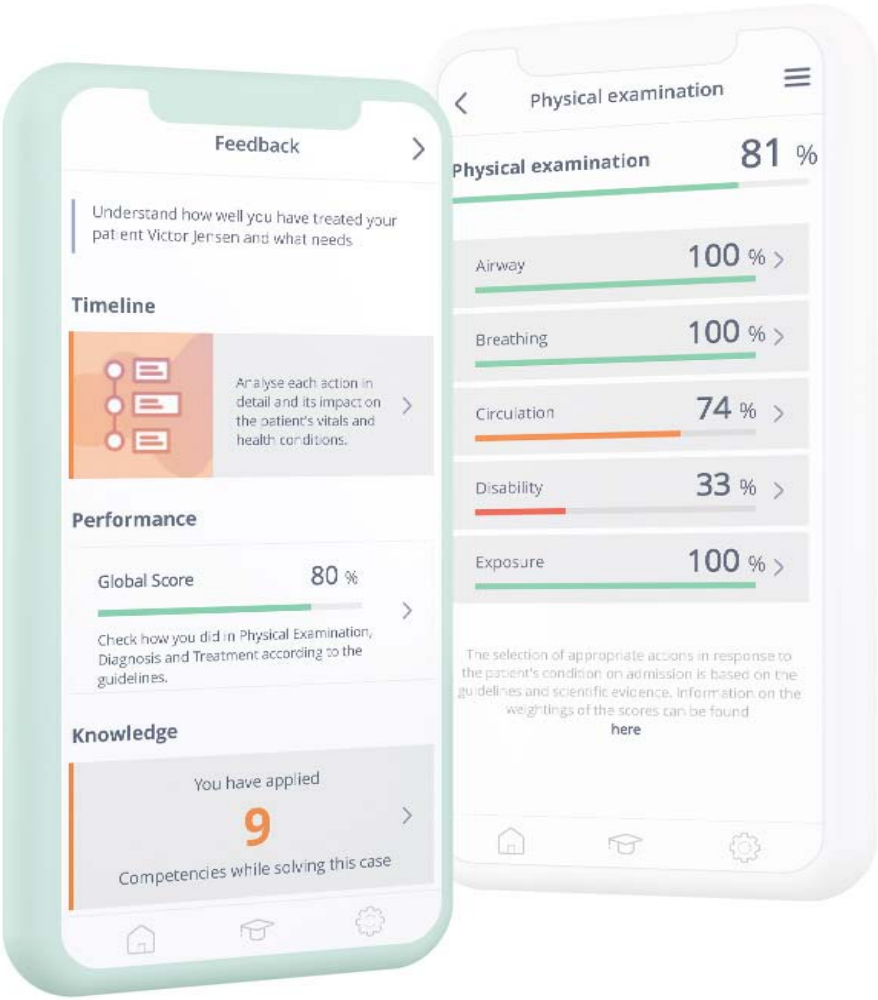

Figure 11: Example of feedback given after the scenario is completed on the Virtual Patient Simulator

VII. Conduct of the study:

Before the simulation session, participants received a brief introduction to the VPS and then completed the pre-session questionnaire (U0). The simulation sessions took place in groups of five to nine students. They comprised a sample clinical case introducing the functionality of the VPS, followed by two clinical cases chosen by the tutor. The clinical cases were done in French, and were of a low to moderate level of difficulty, to accommodate the heterogenous groups of participants. After the session, participants completed the post-session questionnaire (U1). All questionnaires were submitted online.

VIII. The questionnaire:

It was constructed after a literature review and consultation with health education experts. It consisted of two questionnaires: pre-session and post-session questionnaires.

The participants' level in English was sufficient enough to thoroughly understand the questionnaire.

Reliability coefficients for the pre- and post-session questionnaires were determined based on iterative integration of medical school, resulting in an *alpha Cronbach* (α) of 0.917 for U0, confirming good reliability of the instrument (see below in appendix 1).

IX. Statistical analysis :

A descriptive statistical analysis of the socio-demographic characteristics of the participants and the data from the pre-session questionnaire (U0), and a comparative analysis of the data from the pre-session and post-session questionnaires (U0/U1) was performed using the Jamovi and CRAN-R software.

RESULTS

I. Descriptive analysis:

1. Participants:

Our study included 122 participants, all of whom filled the questionnaire.

2. Socio-demographic characteristics:

2.1.

72.1% of our participants were female (Figure 12).

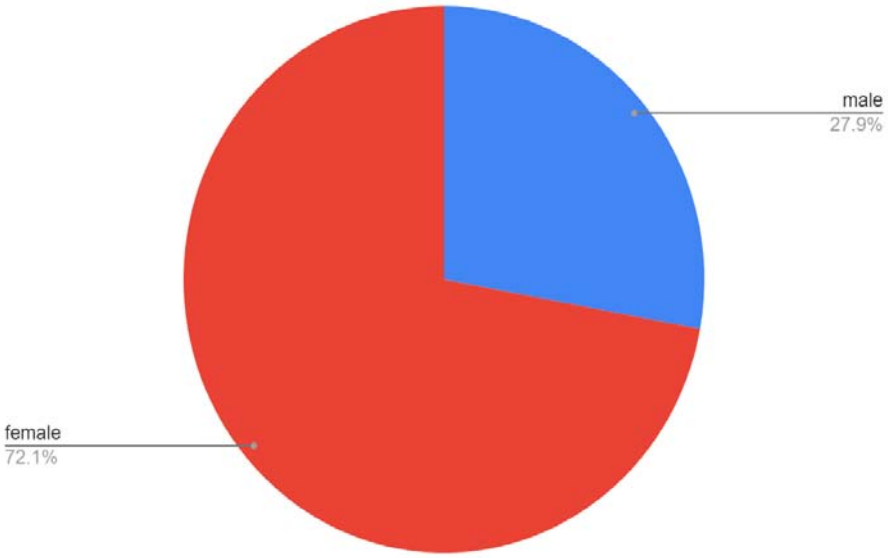

Figure 12: Pie chart representing the number of female vs. male students

2.2. Course year:

The fifth years were the most represented (60.7%), the 7th year the least with two students (1.6%). (Figure 13)

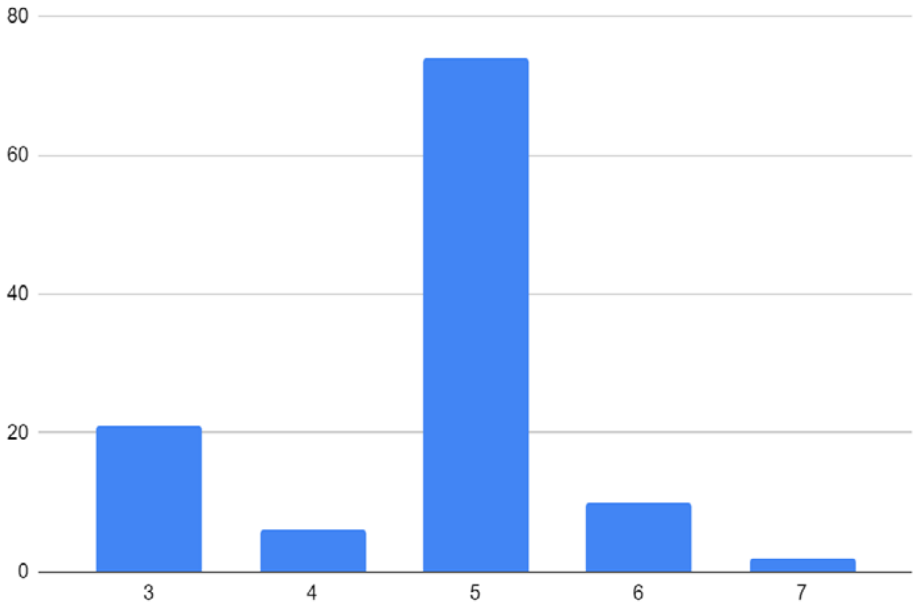

Figure 13: Column chart representing the number of students in each course year

3. Students' perception of their current individual learning process:

When participants were asked whether their studies were "mainly focused on theory," scores were 4.82 ± 1.559 on a 7-point Likert scale; when they were asked whether their "learning process allows for suitable development of communication skills," average responses were 4.22 ± 1.524. (Table I)

Table I: mean scores of students' answers regarding their perception of their current individual learning process.

Question	Mean	Standard Deviation
U0.1 I am able to organise my reasoning.	4.62	1.332
U0.2 My studies are mainly focused on theory.	4.82	1.559
U0.3 My studies balance theoretical studies with the practical application of knowledge	4.39	1.608
U0.4 My learning process allows for suitable development of my communication skills.	4.22	1.524
U0.5 My learning process allows me to build my confidence (in my knowledge and in the decision-making process).	4.47	1.682
U0.6 My learning process allows me to develop my skills in group management and conflict management.	4.33	1.593
U0.7 My clinical experience is appropriate for my knowledge level.	4.25	1.475
U0.8 My simulation experience is appropriate for my knowledge level.	4.56	1.696

4. Student's perception of their current pedagogical process:

Students' responses about their current pedagogical process, when asked whether "the course content is well integrated and connected with each other," averaged 4.32 ± 1.422. And when they were asked whether "the teaching methods in their course are appropriate," average responses were 4.07 ± 1.368. (Table II)

Table II :Mean scores of the students' answers about their perception of their current pedagogical process.

Question	Mean	Standard Deviation
U0.9 In my course the content is well integrated and connected with each other.	4.32	1.422
U0.10 In my course there are opportunities to apply new learning to practical clinical cases.	4.62	1.602
U0.11 In my course we have the opportunity to participate in clinical simulations.	4.73	1.676
U0.12 In my course there is adequate training in communication techniques.	3.83	1.514
U0.13 In my course there is discussion/debate of clinical decisions in a controlled learning environment.	4.41	1.503
U0.14 My course helps me build the personal confidence necessary to function as a future professional.	4.30	1.514
U0.15 I consider the teaching methods in my course appropriate.	4.07	1.368

5. Student's expectations about the use of the Body Interact VPS:

Concerning the students' expectations about using the BI VPS, when asked about their "expectations regarding the use of BI as a new learning tool," scores were 6.07 ± 1.214. When asked about their "expectations regarding using Body Interact as a simulator," students' responses averaged 6.18 ± 1.099. (Table III)

Table III : Mean scores of the students' answers concerning their expectations about using the BI VPS.

Question	Mean	Standard deviation
U0.16 Expectations regarding the use of Body Interact as a new learning tool.	6.07	1.214
U0.17 Expectations regarding the use of Body Interact as a technological resource for learning.	6.11	1.130
U0.18 Expectations regarding using Body Interact as a simulator.	6.18	1.099

6. Student's perception of their learning experience expectations with the Body Interact VPS:

When students were asked whether they "expect that BI will become an importantlearning tool," the mean score was 6.46 ± 0.892; and when asked whether they "expect that Body Interact will validate the competencies they have already acquired through simulation," responses averaged 6.13 ± 1.060, highlighting the students' high expectations. (Table IV)

Table IV : Mean scores of the students' answers concerning their perception of their learning experience expectations with the BI VPS.

Question	Mean	Standard Deviation
U0.19 I expect that Body Interact will help to fill in the learning gaps in the teaching process.	6.16	1.068
U0.20 I expect that Body Interact will help to fill in the individual gaps in my current learning.	6.16	0.988
U0.21 I expect that Body Interact will provide real feedback on my learning.	6.31	0.891
U0.22 I expect that Body Interact will help me identify individual weaknesses in my competencies.	6.15	1.088
U0.23 I expect that Body Interact will give me clinical experience (through simulation).	6.28	0.884
U0.24 I expect that Body Interact will validate the competencies I have already acquired (through simulation).	6.13	1.060
U0.25 I expect that Body Interact will help me practise decision-making strategies.	6.17	1.002
U0.26 I expect that Body Interact will help me to transform clinical decision-making errors into a constructive learning process.	6.27	0.979
U0.27 I expect that Body Interact will become an important learning tool.	6.46	0.892

II. Comparative analysis:

1. Students' perception of their current individual learning process after the experience with the Body Interact simulator:

After using the BI VPS, the difference between responses was statistically significant. (Table V)

Table V : comparison of the students' mean scores regarding their perception of their current individual learning process before and after using the Body Interact VPS.

Pre-session question	Post-session question	Meanpre-session	Mean post-session	p
U0.1 I am able to organise my reasoning.	U1.1 I am able to organise my reasoning.	4.62 ± 1.332	5.19 ± 1.363	<0.001
U0.2 My studies are mainly focused on theory.	U1.2 My studies are mainly focused on theory.	4.82 ± 1.559	4.73 ± 1.601	0.515
U0.3 My studies balance theoretical studies with the practical application of knowledge.	U1.3 My studies balance theoretical studies with the practical application of knowledge.	4.39 ± 1.608	4.85 ± 1.458	0.001
U0.4 My learning process allows for suitable development of my communication skills.	U1.4 My learning process allows for suitable development of my communication skills.	4.22 ± 1.524	4.85 ± 1.441	<0.001

U0.5 My learning process allows me to build my confidence (in my knowledge and in the decision-making process).	U1.5 My learning process allows me to build my confidence (in my knowledge and in the decision-making process).	4.47 ± 1.682	4.91 ± 1.532	0.002
U0.6 My learning process allows me to develop my skills in group management and conflict management.	U1.6 My learning process allows me to develop my skills in group management and conflict management.	4.33 ± 1.593	4.96 ± 1.561	<0.001

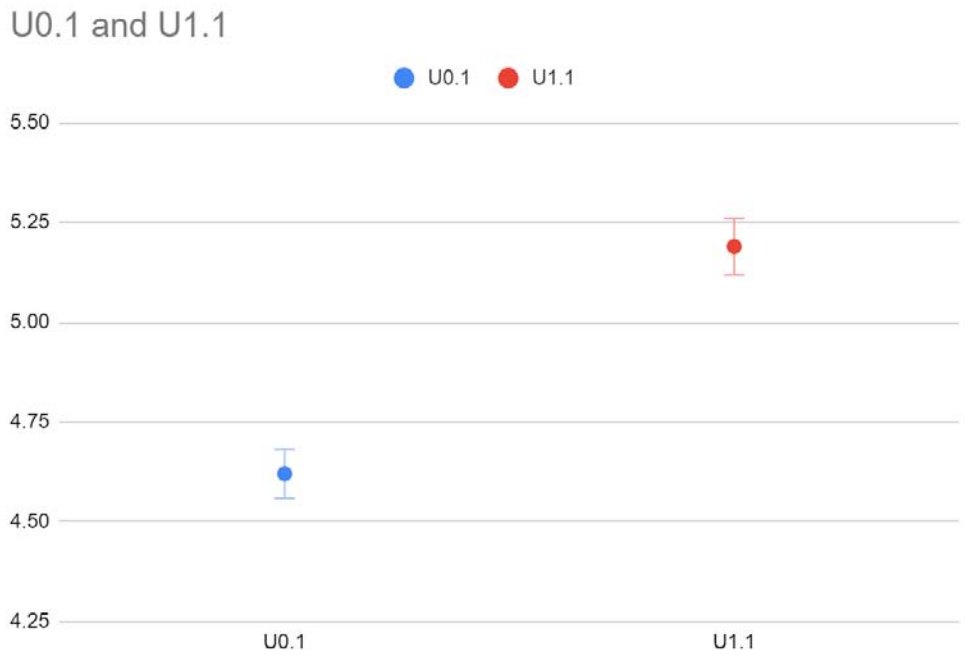

Figure 14 : Mean difference of students' score to "I am able to organize my reasoning" before and after using the BI VPS"

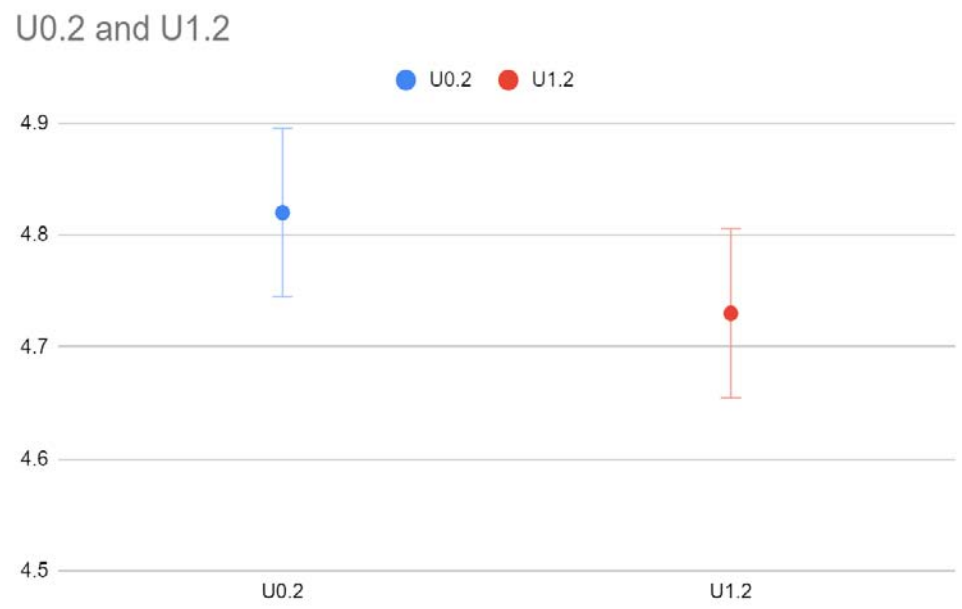

Figure 15: Mean difference of students' scores when asked if "their studies are mainly focused on theory"

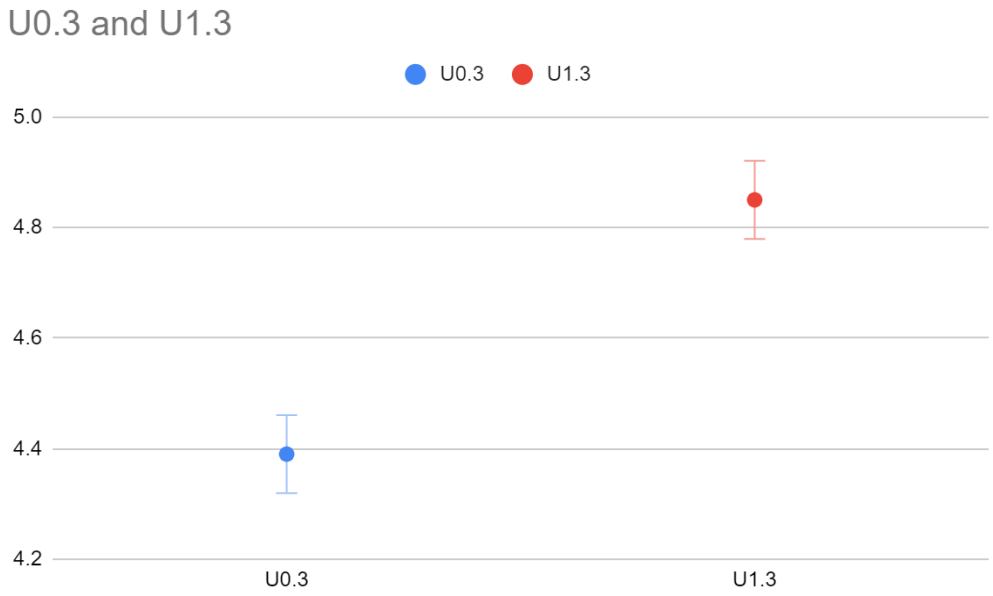

Figure 16: Mean difference of students' answers to "My studies balance theoretical studies with the practical application of knowledge"

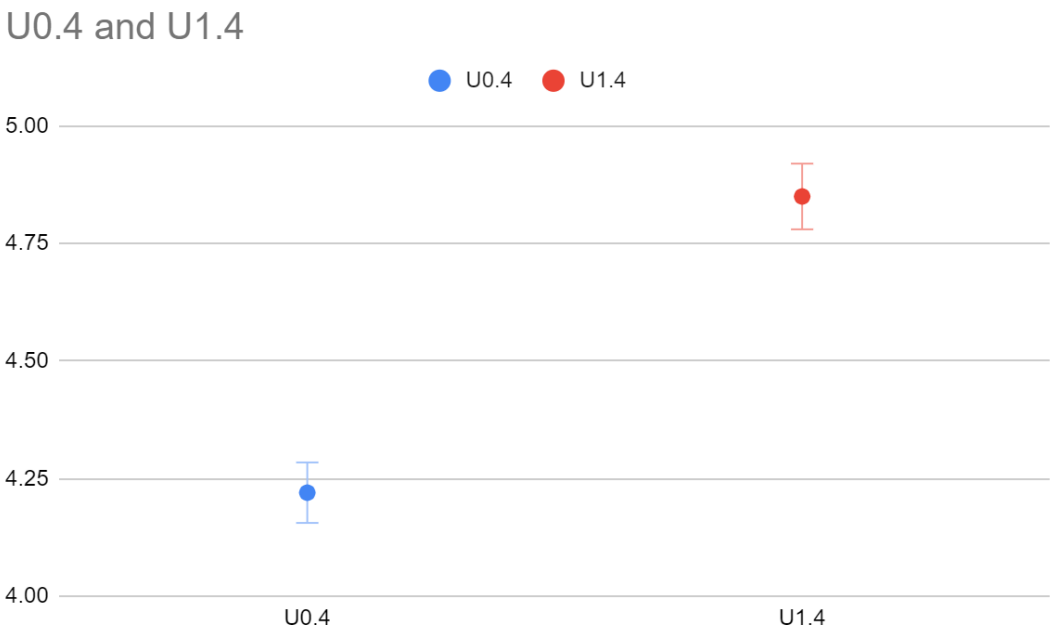

Figure 17: Mean difference of students' scores when asked "My learning process allows for suitable development of my communication skills"

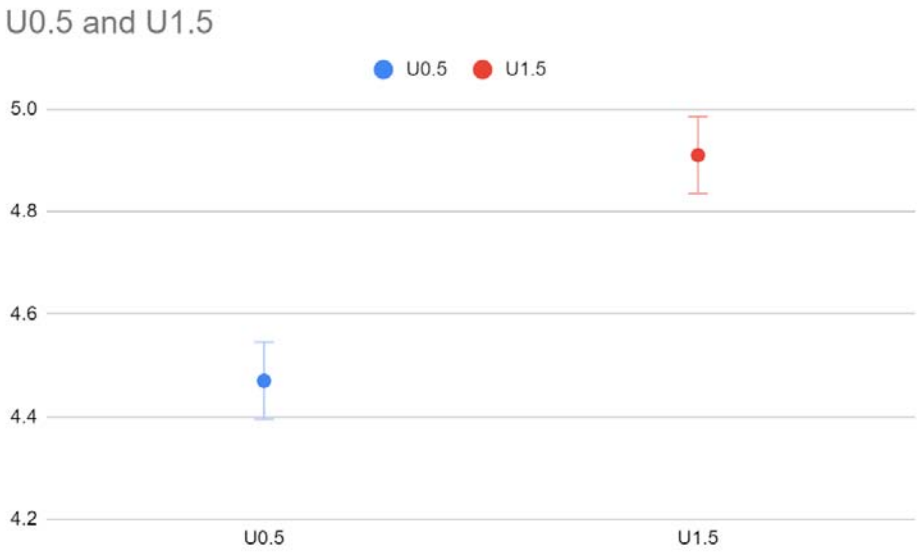

Figure 18: Mean difference of students' answers to "My learning process allows me to build my confidence (in my knowledge and in the decision-making process)

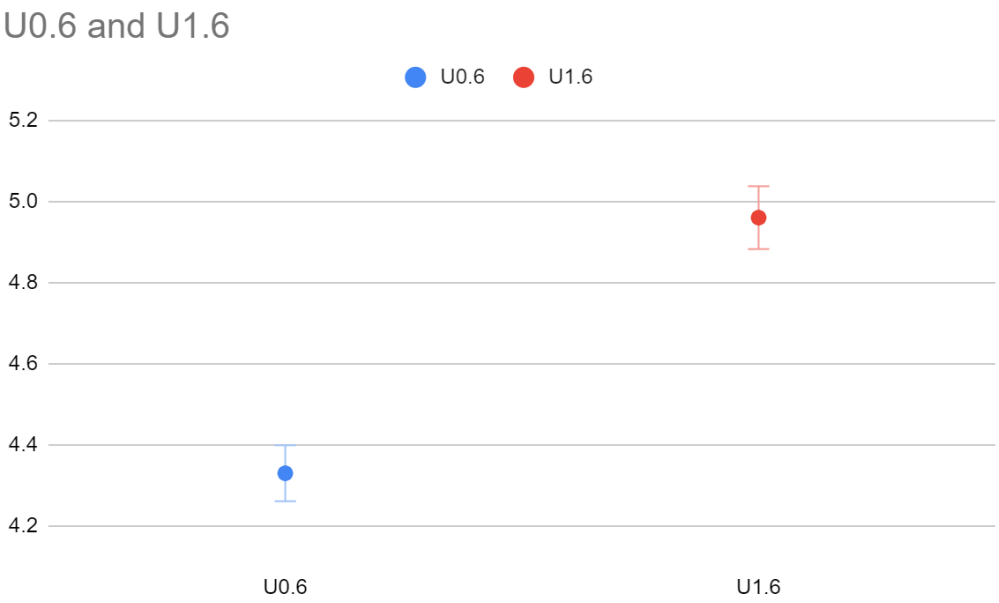

Figure 19: Mean difference of students' scores in answer to "My learning allows me to develop my skills in group management and conflict management"

2. Students' perception of their gaps in the current pedagogical process after the experience with the Body Interact simulator:

Students' average responses about their perceived gaps in the current pedagogical process have all known a statistically significant improvement. (Table VI)

Table VI :Comparison of the students' mean scores concerning their perception of their gaps in the current pedagogical process before and after using the Body Interact VPS.

Pre-session question	Post-session question	Meanpre-session	Mean post-session	p
U0.9 In my course the content is well integrated and connected with each other.	U1.7 In my course the content is well integrated and connected with each other.	4.32 ± 1.422	5.02 ± 1.357	<0.001
U0.10 In my course there are opportunities to apply new earning to practical clinical cases.	U1.8 In my course there are opportunities to apply new learning to practical clinical cases.	4.62 ± 1.602	5.19 ± 1.416	<0.001
U0.11 In my course we have the opportunity to participate in clinical simulations.	U1.9 In my course we have the opportunity to participate in clinical simulations.	4.73 ± 1.676	5.39 ± 1.502	<0.001
U0.12 In my course there is adequate training in communication techniques.	U1.10 In my course there is adequate training in communication techniques.	3.83 ± 1.514	4.76 ± 1.691	<0.001
U0.13 In my course there is discussion/debate of clinical decisions in a controlled learning environment.	U1.11 In my course there is discussion/debate of clinical decisions in a controlled learning environment.	4.41 ± 1.503	4.94 ± 1.517	<0.001
U0.14 My course helps me build the personal confidence necessary to function as a future professional.	U1.12 My course helps me build the personal confidence necessary to function as a future professional.	4.30 ± 1.514	4.98 ± 1.595	<0.001
U0.15 I consider the teaching methods in my course appropriate.	U1.13 I consider the teaching methods in my course appropriate.	4.07 ± 1.368	4.98 ± 1.587	<0.001

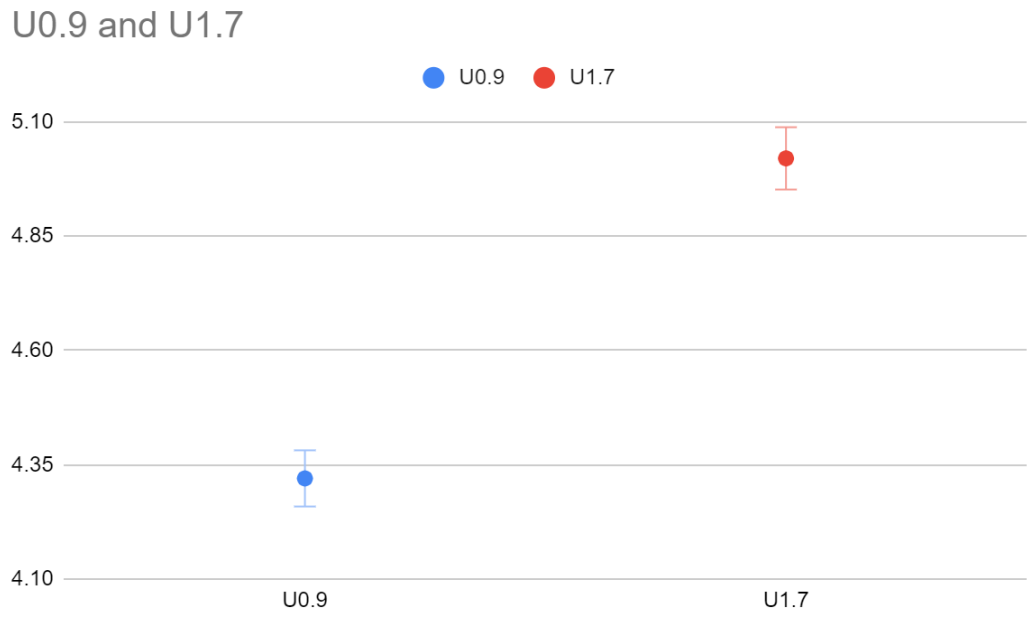

Figure 20: Mean difference of students' scores when asked "in my course the content is well integrated and connected with each other"

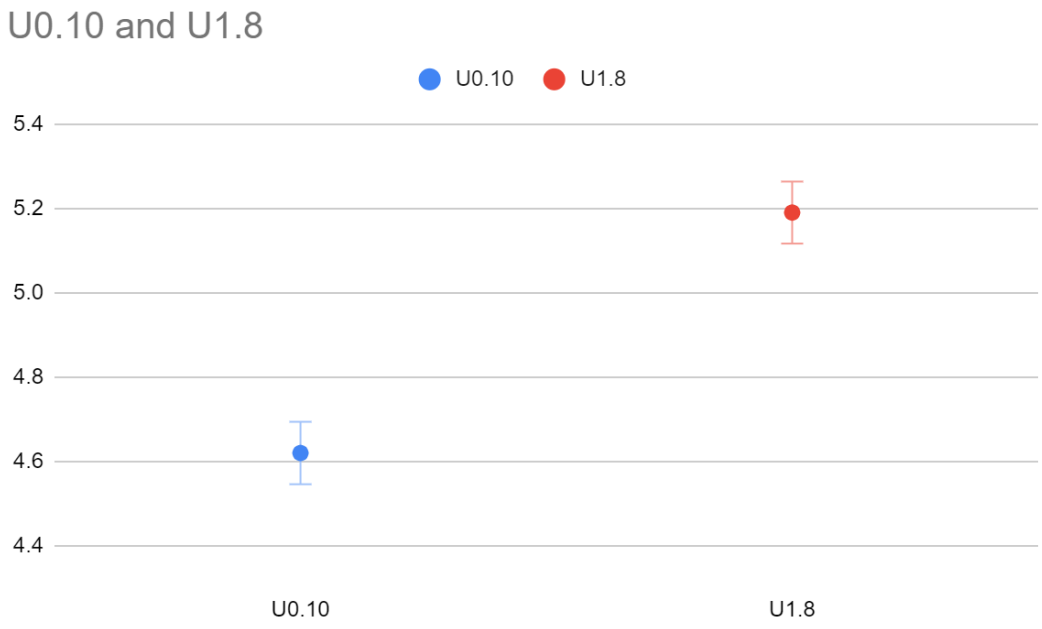

Figure 21: Mean difference of students' average answers to "in my course there are opportunities do apply new learning to practical clinical cases"

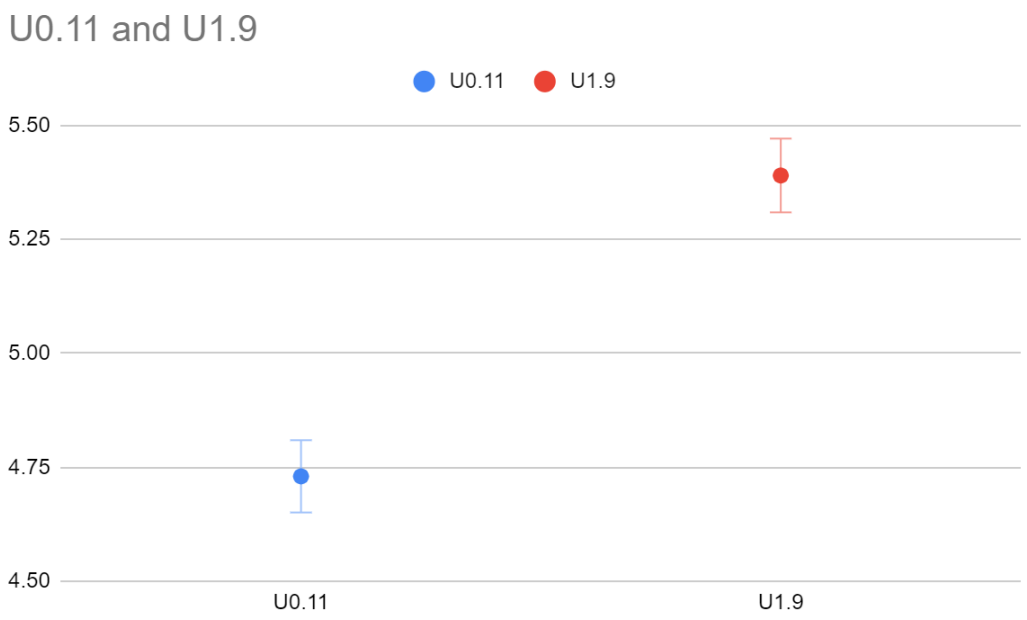

Figure 22: Mean difference of students' scores to "in my course we have the opportunity to participate in clinical simulations"

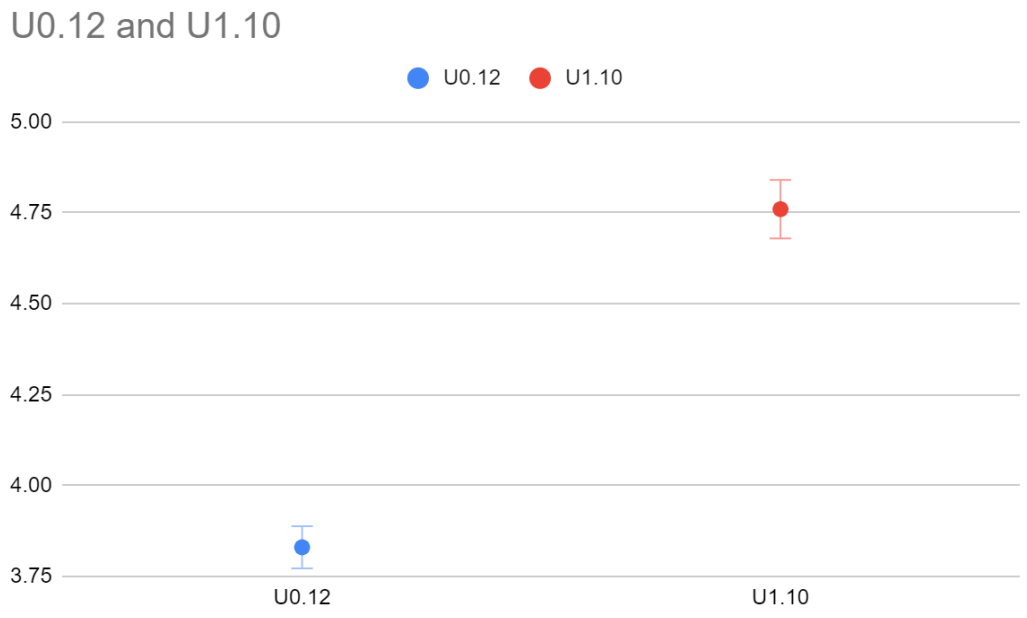

Figure 23: Mean difference of students' scores when asked "in my course there is adequate training in communication techniques"

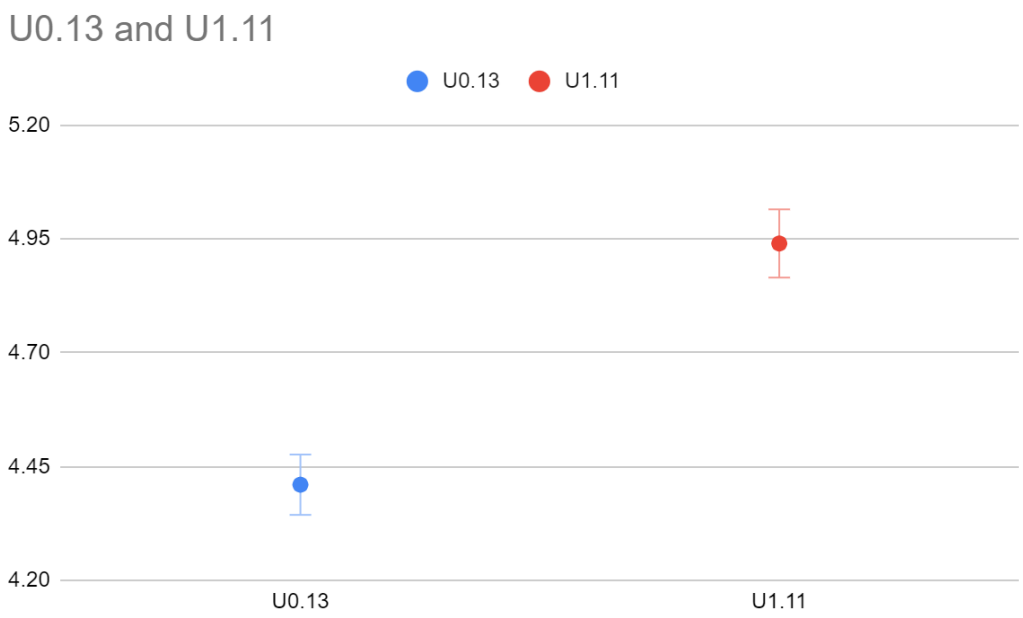

Figure 24: Mean difference of students' scores to "In my course there is discussion/debate of clinical decisions in a controlled learning environment"

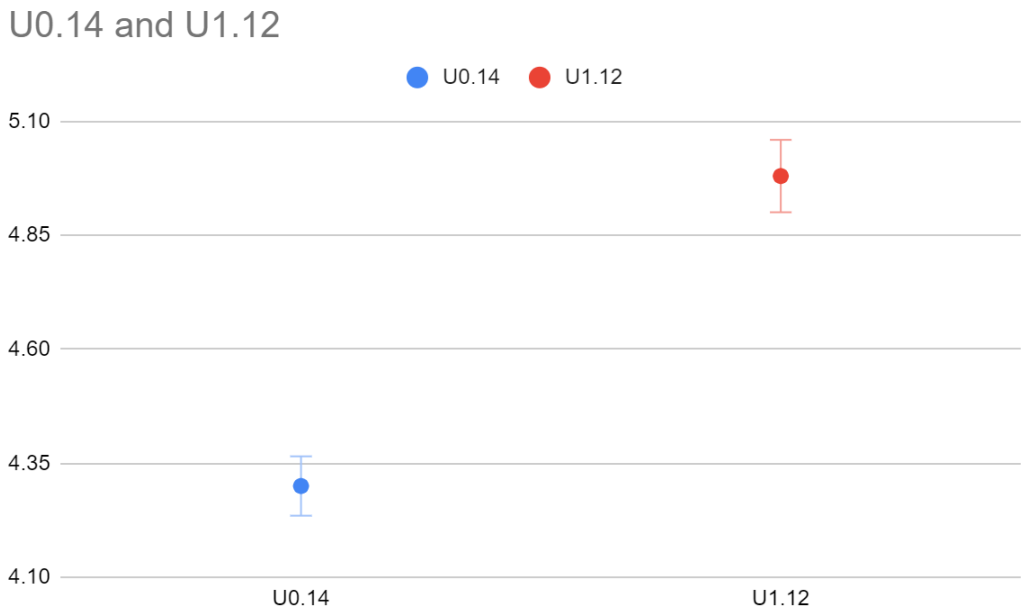

Figure 25: Mean difference of students' average answers to "My course helps me build the personal confidence necessary to function as a future professional"

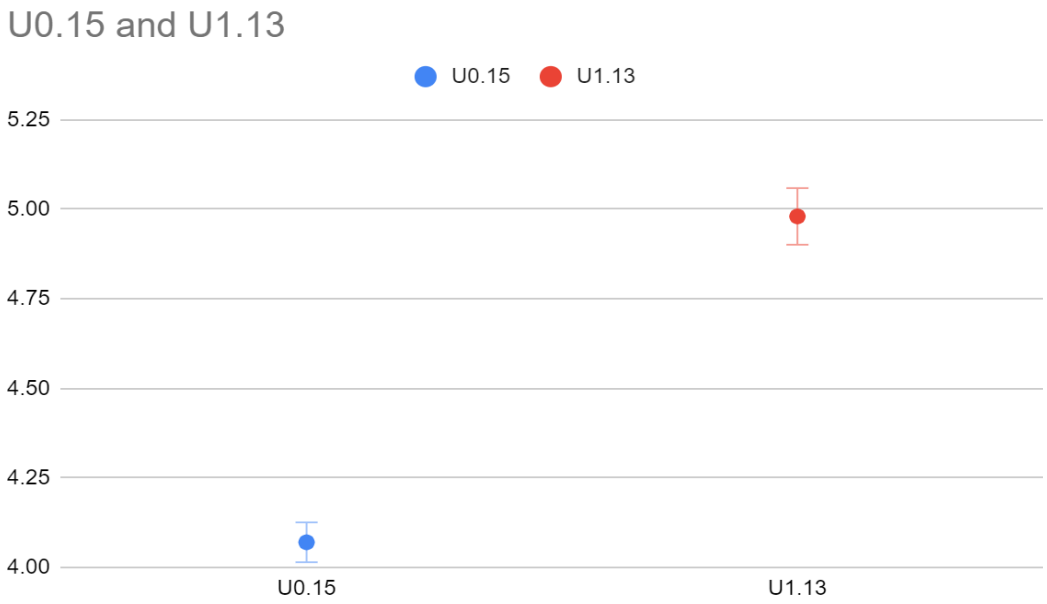

Figure 26: Mean difference of students' average answers to "I consider the teaching methods in my course appropriate"

3. Students' satisfaction with the use of the Body Interact simulator:

When asked about their satisfaction with using the BI VPS, all scores have improved with a statistically significant difference, thus demonstrating the students' satisfaction with the Body Interact Virtual Patient Simulator and their positive perception of its use as a learning tool. (Table VII)

Table VII :Comparisonof the students' mean scores about their satisfaction with using the BI VPS before and after using the BI VPS.

Pre-session question	Post-session question	Meanpre-session	Mean post-session	p
U0.16 Expectations regarding the use of Body Interact as a new learning tool.	U1.14 Satisfaction level regarding the use of Body Interact as a new learning tool.	6.07 ± 1.214	6.54 ± 0.694	<0.001
U0.17 Expectations regarding the use of Body Interact as a technological resource for learning.	U1.15 Satisfaction level regarding the use of Body Interact as a technological resource for learning.	6.11 ± 1.130	6.53 ± 0.773	<0.001
U0.18 Expectations regarding using Body Interact as a simulator.	U1.16 Satisfaction level regarding the use of the Body Interact as a simulator.	6.18 ± 1.099	6.64 ± 0.617	<0.001

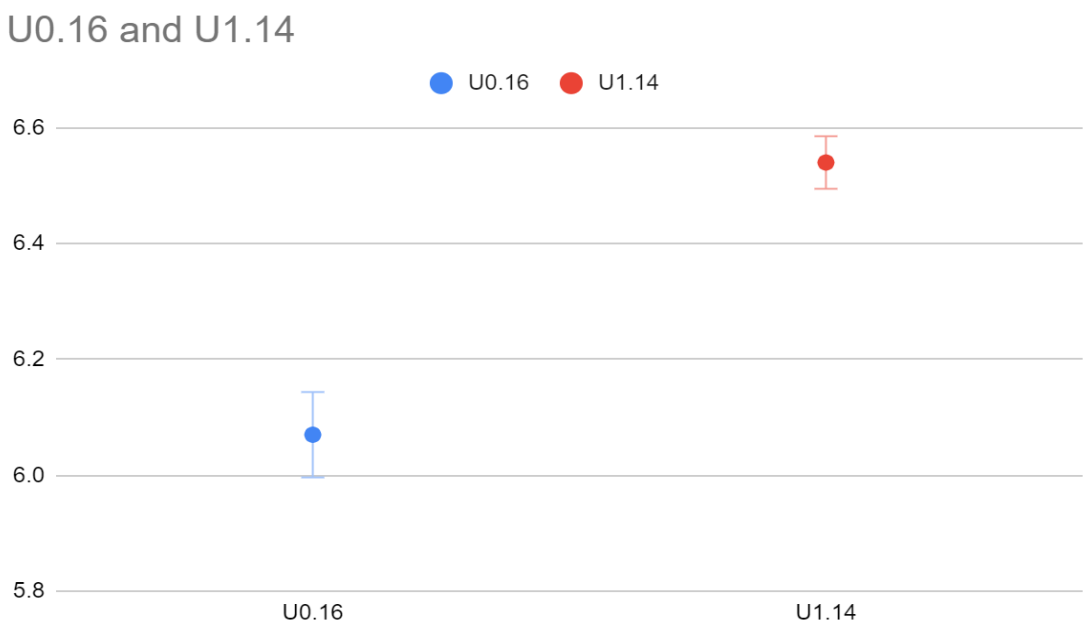

Figure 27 :Mean difference of students' scores to "expectations/satisfaction level regarding the use of BI as a new learning tool"

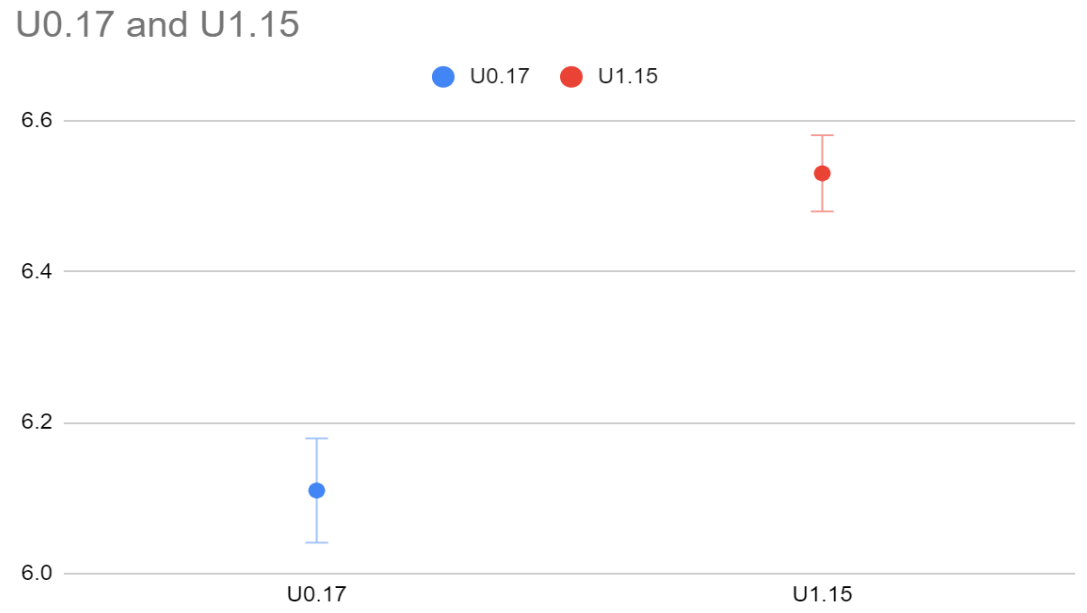

Figure 28 :Mean difference of students' scores regarding "expectations/satisfaction level regarding the use of BI as a technological resource for learning"

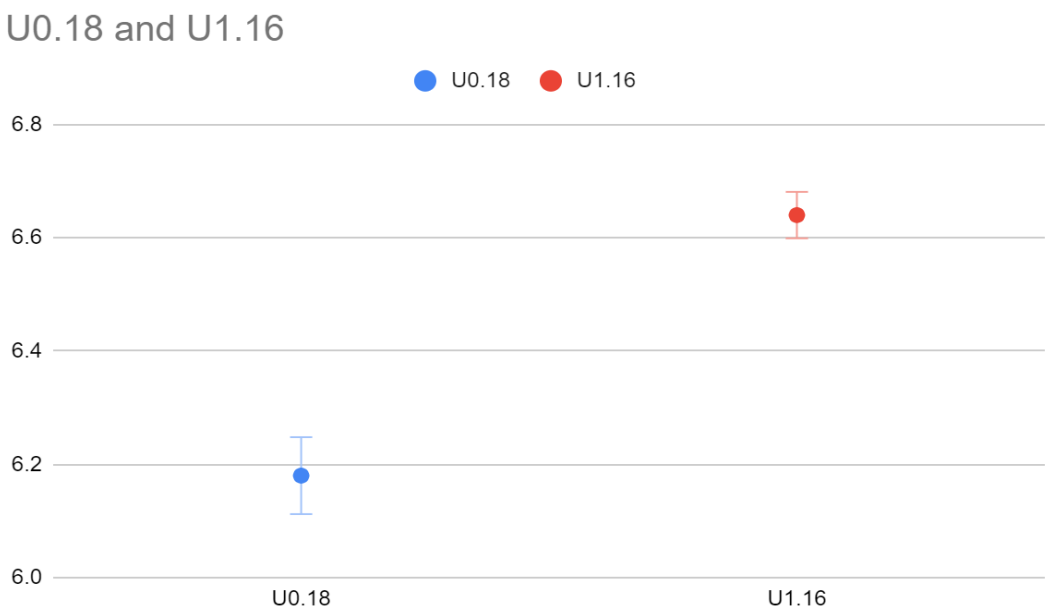

Figure 29 :Mean difference of students' scores to "expectations/satisfaction level regarding the use of BI as a simulator"

4. Student's perception of their learning experience with the Body Interact simulator:

Students' average responses concerning whether or not the BI VPS "enabled them to o identify individual weaknesses in their competencies" and whether or not "it gave them clinical experience (through simulation)" have improved with a statistically significant difference. (Table VIII)

Table VIII :Comparison of the students' mean scores before and after using the BI VPS for section 4 of the questionnaire regarding their perception of their learning experience with the BI VPS.

Pre-session question	Post-session question	Meanpre-session	Mean post-session	p
U0.19 I expect that Body Interact will help to fill in the learning gaps in the teaching process.	U1.17 Body Interact allowed me to bridge the learning gaps in the teaching process.	6.16 ± 1.068	6.34 ± 0.811	0.052
U0.20 I expect that Body Interact will help to fill in the individual gaps in my current learning.	U1.18 Body Interact helped me to bridge the learning gaps in my own learning.	6.16 ± 0.988	6.42 ± 0.770	0.005
U0.21 I expect that Body Interact will provide real feedback on my learning.	U1.19 Body Interact provided real feedback on my learning.	6.31 ± 0.891	6.52 ± 0.730	0.027
U0.22 I expect that Body Interact will help me identify individual weaknesses in my competencies.	**U1.20 Body Interact enabled me to identify individual weaknesses in my competencies.**	**6.15 ± 1.088**	**6.51 ± 0.707**	**<0.001**
U0.23 I expect that Body Interact will give me clinical experience (through simulation).	**U1.21 Body Interact gave me clinical experience (through simulation).**	**6.28 ± 0.884**	**6.57 ± 0.667**	**<0.001**
U0.24 I expect that Body Interact will validate the competencies I have already acquired (through simulation).	U1.22 Body Interact validates the competencies I have already acquired.	6.13 ± 1.060	6.39 ± 0.858	0.012
U0.25 I expect that Body Interact will help me practice decision-making strategies.	U1.23 Body Interact helped me practice decision-making strategies.	6.17 ± 1.002	6.43 ± 0.771	0.008
U0.26 I expect that Body Interact will help me to	U1.24 Body Interact turned clinical decision-making	6.27 ± 0.979	6.46 ± 0.794	0.021

transform clinical decision-making errors into a constructive learning process.	errors into a constructive learning process.			
U0.27 I expect that Body Interact will become an important learning tool.	U1.25 Body Interact is an important learning tool.	6.46 ± 0.892	6.66 ± 0.638	0.022

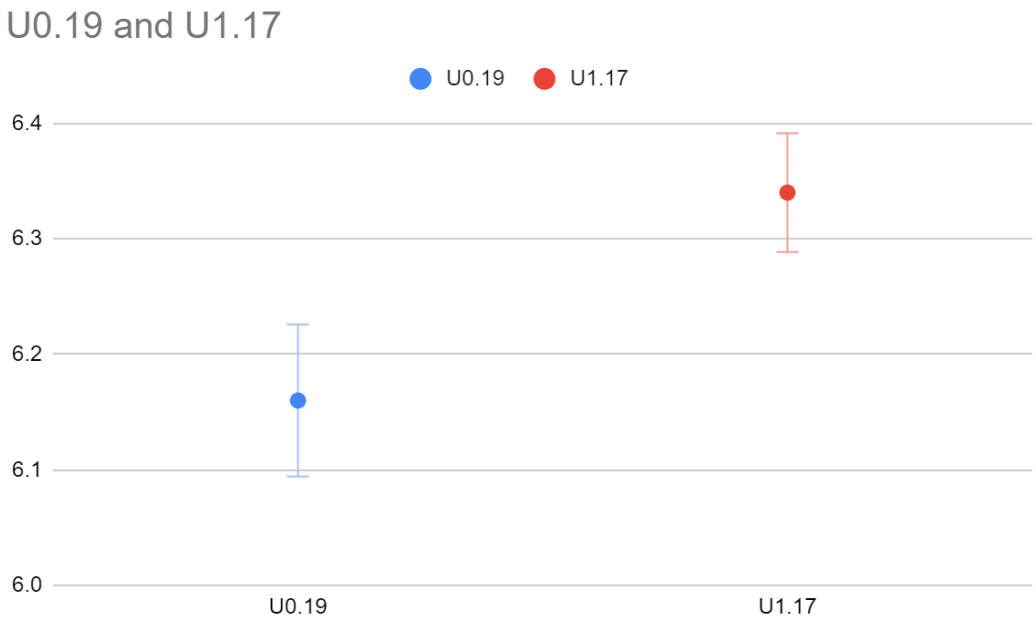

Figure 30: Mean difference of students' average answers to "BI allowed me to bridge the learning gaps in the teaching process"

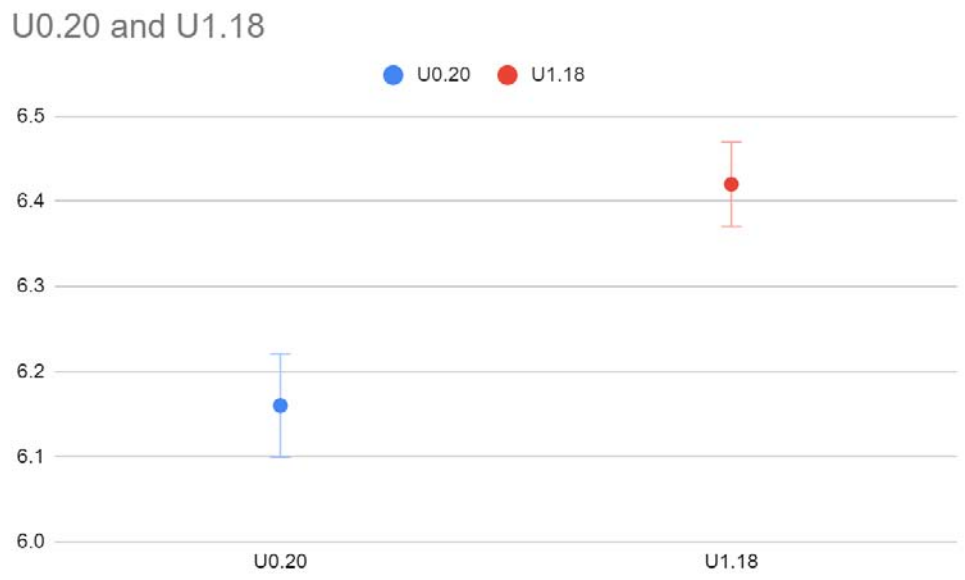

Figure 31: Mean difference of students' average answers when asked if "BI helped me to bridge the learning gaps in my own learning"

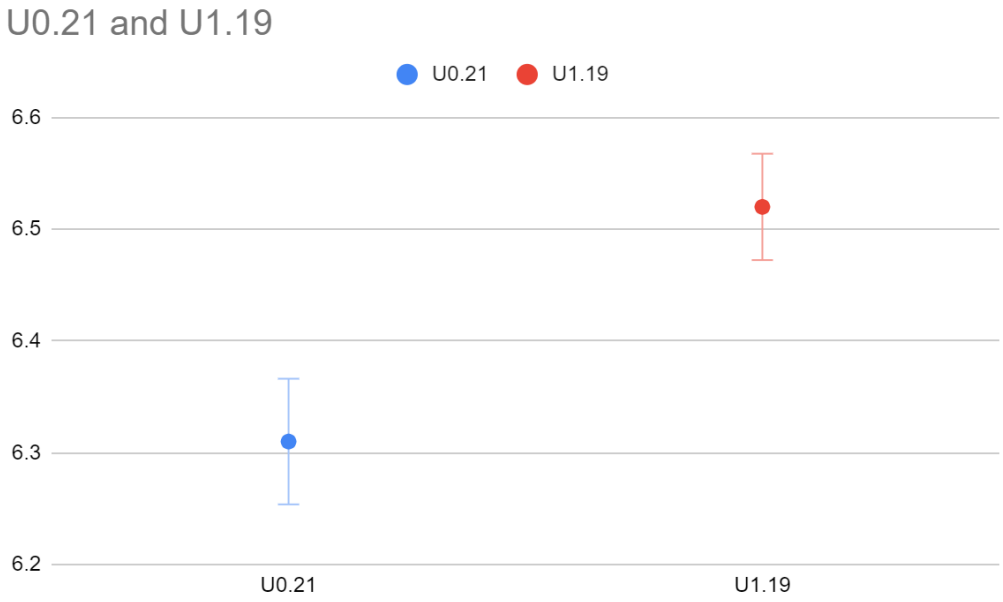

Figure 32: Mean difference of students' scores to "BI provided real feedback on my learning"

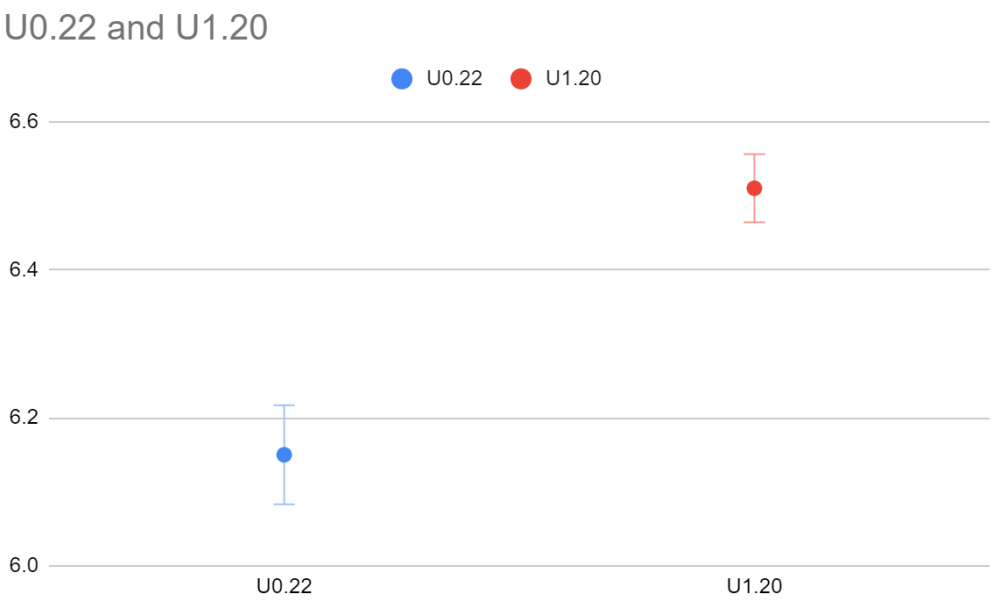

Figure 33: Mean difference of students' scores when asked "BI enabled me to identify weaknesses in my competencies"

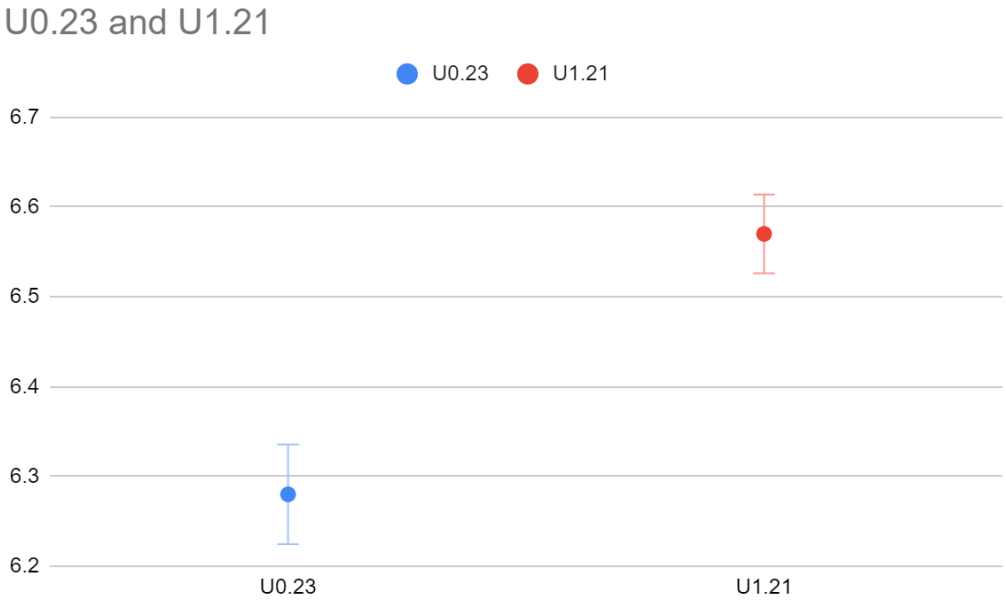

Figure 34: Mean difference of students' average answers when asked "BI gave me clinical experience (through simulation)"

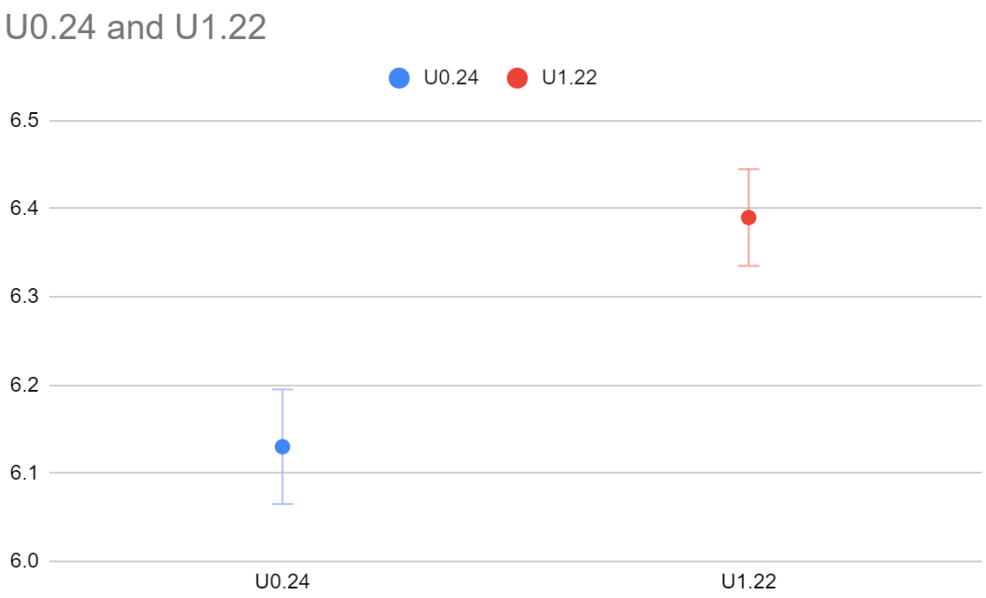

Figure 35: Mean difference of students' average answers concerning "BI validates the competencies I have already acquired"

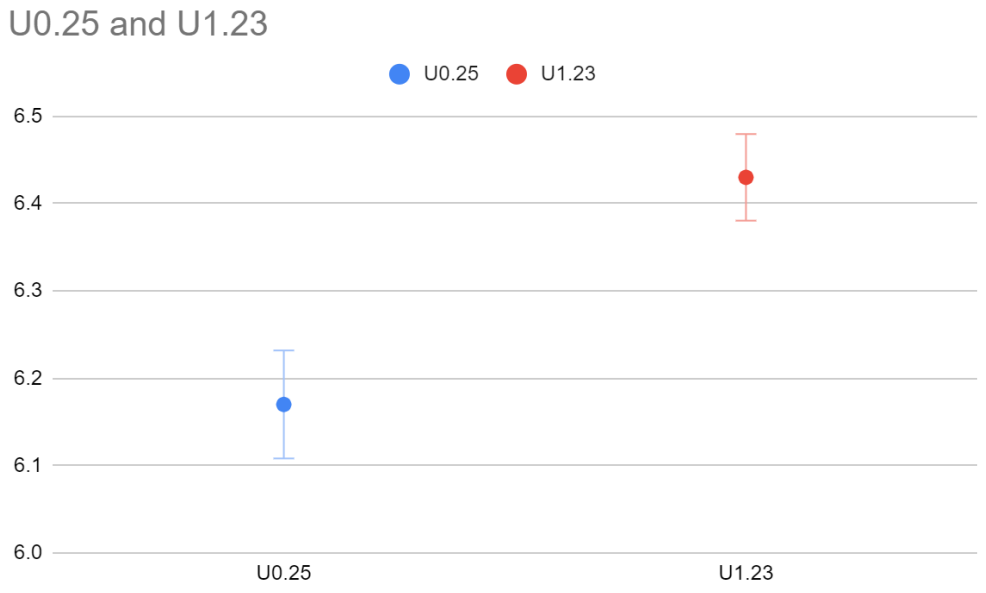

Figure 36: Mean difference of students' average answers to "BI helped me practise decision-making strategies"

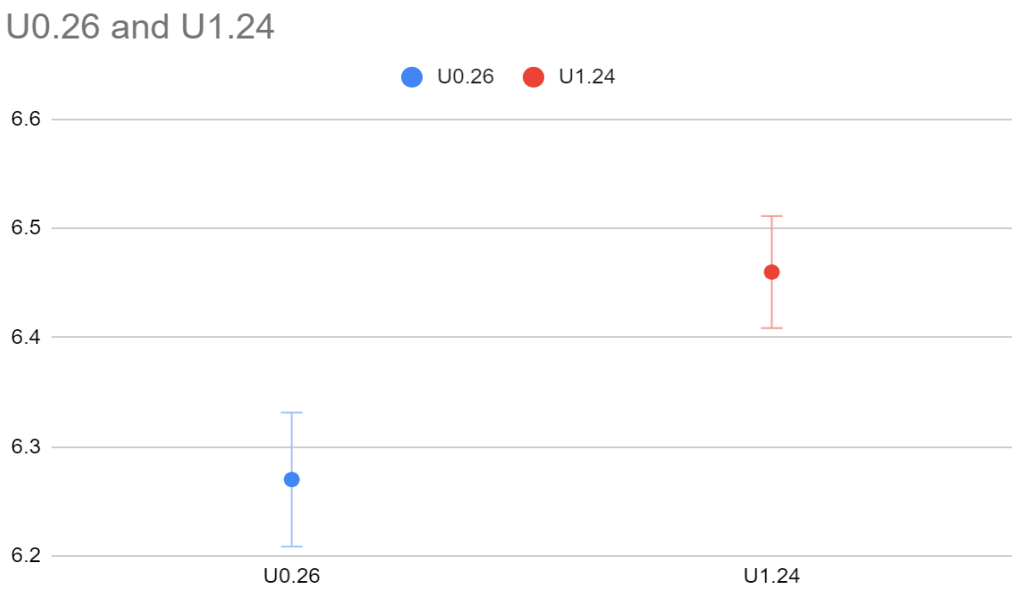

Figure 37: Mean difference of students' scores to "BI turned clinical-decision making errors into a constructive learning process"

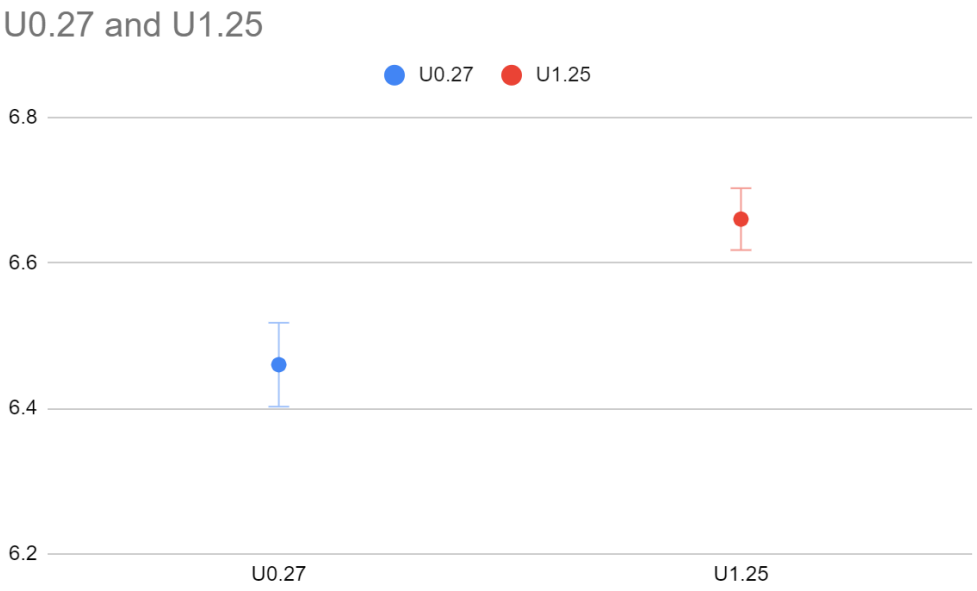

Figure 38: Mean difference of students' average answers when asked "BI is an important learning tool"

5. Student's perception of the level of importance they attach to training that uses simulation with virtual patients:

When participants were asked about the "development of decision-making skills" after using the BI VPS, their scores were 6.45 ± 0.694. When asked about their "organization of reasoning and critical thinking," their responses averaged 6.54 ± 0.706 (Table IX).

Table IX : Mean scores of the students' answers regarding the importance they attach to training that uses VPS.

Question	Mean	SD
U1.26. Development of decision-making skills.	6.45	0.694
U1.27. Development of independent learning skills.	6.43	0.692
U1.28. Simulation training.	6.58	0.690
U1.29. Organisation of reasoning and critical thinking.	6.54	0.706
U1.30. Constructive feedback.	6.52	0.683
U1.31. Ability to repeat clinical cases.	6.48	0.763
U1.32. Complexity level of health conditions and clinical cases.	6.45	0.728

The data demonstrates the positive impact that Body Interact has had on our students and their enthusiasm for using the VPS as a learning tool. Their perception of the Body Interact VPS is positive, and their decision-making skills and clinical reasoning capabilities seem to benefit from it.

DISCUSSION

I. Gamification, serious games, and game-based learning: what they are, and why should we use them:

Gamification refers to applying game elements to serious purposes, such as levels and rewards [12, 13]. Serious games are intended for purposes other than entertainment, be it learning, simulation, or training [14].

Game-based learning combines these concepts to turn students into players. They test and use their problem-solving capabilities through challenges to give them the sense of achievement that traditional games provide [15, 16].

Strictly theoretical learning does not prepare students for the professional situations they will eventually go through, nor does it provide them with the soft skills they need to succeed, notably critical thinking, decision-making, and communication [17]. This is where game-based learning comes through. By contextualising knowledge and adding a practical consequence to mere facts, students become active learners with increased interest and motivation facts [18, 19]. Furthermore, by using a VPS in the early stages of learning, students test their knowledge and abilities with no risk to patients' lives and repeat the experience as many times as needed until the goal is achieved [20]. Some authors worried about the gap between reality and virtual reality widening, and students losing grasp on reality. However these alternative methods are not here to replace traditional teaching methods but rather to enhance them and bridge the gaps left by insufficient resources. Ultimately the students will have developed the right instincts and confidence they need by the time they start practising with patients.

Though some authors would argue that a more motivated student, a student who is having fun in the classroom, is enough to advocate for the pedagogical use of games [21, 22], we do need more concrete data to prove beyond doubt the impact of those serious games on medical students, hence the importance of studies like ours.

II. Students' perception of their individual learning process and the gaps in the pedagogical process:

Our students' perception of their current individual learning process has significantly improved after using BI VPS, in agreement with the study of Nabhani et al. [23] in which they demonstrated that students reported a significant enhancement of their confidence ability. Similarly, our students reported better scores in balancing theoretical knowledge with practical application and organizing their reasoning. In agreement, Lebdai et al. [24] demonstrated that the mean grades of the group of students that used the Immersive VPS were were significantly higher than the control group's.

As for the students' perceived gaps in their current pedagogical process, the scores have significantly improved, fitting the literature. Namely, the items regarding the adequacy of their teaching methods, the integration of their course, and the opportunity to apply their learning in practical cases and debate clinical decisions in a safe environment all significantly improved. Correspondingly, Palee et al. [25] tested students before and after the use of the serious game and found that their scores went from 63% to 85% correct answers, highlighting the positive impact of the serious game on medical students' use of their knowledge. Moreover, after using a 3D virtual reality program, Alharbi et al. [26] concluded that students scored higher than those who used traditional learning methods.

III. Students' satisfaction with the use of the BI VPS:

The students' expectation scores were already high. After using the BI VPS, their scores have still shown significant improvement, complying with a previous study conducted in our faculty by Kherchtto et al. [27]. They confirmed that students rated the serious game at a high level of satisfaction as a tool to enhance their knowledge and improve their clinical reasoning. Students found it an adequate resource for learning and simulation training; in line with the study ofTsopra et al. [28] who showed that 93% of the students found the game relevant to their

course and 98% found it made learning easier and fun. Meanwhile, Martin et al [29] tested 19 general surgery residents before and after using the simulator, and announced that their mean scores went from 63% to 85% accurate, showcasing a higher performance and had most of the participants rate the simulator as helpful to their surgical training. In the same light, Overtoom et al. [30] showed that residents rated the usefulness and suitability as an acceptable to a high level, especially in eye-hand coordination training. Similarly, Back et al. [31]demonstrated that most of their participants felt more prepared for clinical situations in their professional career after using the e-learning program and reported that it helped them increase their knowledge.

IV. Soft skills gained by the students after the use of the BI VPS:

Our students found the BI VPS useful in regards to validating their competencies andoffering them the opportunity to practise decision-making. They also felt it provided them with helpful feedback and room to turn errors into a constructive learning process.Marreiros's study [32] stated that a positive impact score was found in items relating to clinical decision-making strategy and opportunities created to participate in the clinical simulation. BI's most significantimprovement was allowing them to identify individual learning weaknesses, and providing them with clinical experience through simulation. They also stated that the BI VPS helped in developing communication skills, group and conflict management skills.This agreed with the findings of Bangalee's study [33] which reported an improvement in group and time management and communication skills. They also estimated that the game helped them identify knowledge gapsand better apply their theoretical knowledge. Likewise, in a meta-analysis, Cook et al. [34] notedthat virtual patients were associated with significant effects on knowledge outcomes and clinical reasoning. Chon et al.[35] found that after using the virtual patient tool, their students asked more diagnostic questions, and chose the correct diagnostic pathways.

We also let our students rate their importance to training that uses a VPS. They gave a high rating to all items, specifically development of decision-making skills, independent learning skills, and organization of reasoning and critical thinking. Similarly, Abreu et al. [7]demonstrated

a statistically significant higher score in tests with Virtual Interactive Patient than with the Multiple Choice Questionnaire (MCQ) method, especially in clinical history and physical examination. In addition, Padilha et al. [36] remarked that their participants rated the BI VPS' usefulness at enhancing clinical reasoning skills at 9.14 out of 10. In the same vein,Watari et al. [11] evaluated their students' knowledge and clinical reasoning using a MCQ before and after using the VPS and found that the students' mean score significantly improved after using the simulator, with the score regarding the clinical reasoning item going from 5.3 to 7.81. Additionally, Kleinert [37] pointed out that after trying a web-based immersive VPS, students' test scores in procedural knowledge items significantly improved, thus cementing it as an effective tool to teach clinical reasoning to medical students.

Our students have also highly rated the feedback provided by the BI VPS and the complexity of the scenarii. They appreciated the simulation training and ability to repeat clinical cases offered by the VPS. This is ultimately the most significant advantage provided by a VPS. As Mariani et al. [38] have pointed out, despite the sometimes high costs of developing such simulators, avoiding complications and wasting pricy materials more than makes up for it. And it makes it easier for the instructor to evaluate students' skills.

V. Limits of our study:

The generalizability of the study is limited by its methodology, which could potentially lead to a few biases.

Firstly, as the students in the study all volunteered to be a part of it, we could be confronted with a self-selection bias [39]. Since the participation was voluntary, the students were already motivated and self-committed. And as with all learning methods, a personal level of motivation is important, and we cannot speak for all students' motivation. We could prevent that by randomly selecting students in a future study.

Secondly, despite the answers being completely confidential and anonymous, the students did fill the questionnaire immediately after trying the VPS, thus risking a social

desirability bias [40]. A way to prevent that would be to let the students fill the questionnaire at a later hour, in their own time and place.

Thirdly, a recency bias could also arise, since there wasn't much time between the pre-session and the post-session questionnaire [41]. As cognitive science tells us, a recent event is often perceived as being more important than it might actually be. A way to prevent that would be to conduct a longer study, and asking the post-session questionnaire at a later date than the session.

And finally, while the students' opinion is primordial when evaluating a teaching method, it is perhaps not enough to state for certain that their clinical reasoning and decision-making skills have indeed improved. In a future study, it would be interesting to conduct a long-term study ultimately testing their procedural knowledge through clinical scenarii for more concrete proof of the impact of VPS [42].

VI. Recommendations:

- Integrate a VPS into the curriculum in addition to traditional teaching methods at the faculty.
- Organize team-based training sessions using a VPS at the simulation laboratory for students to train their clinical reasoning and team-working skills.
- Integrate a VPS into the teaching courses during clinical rotations at the teaching hospital.
- Encourage students to vary their individual learning methods and use a VPS as a training method to develop their clinical reasoning and decision-making abilities.

CONCLUSION

Our results showcase a high expectation from the students towards simulation that uses virtual patients and a certain level of dissatisfaction with their current pedagogical and learning process. After the use of the Body Interact Virtual Patient Simulator, results significantly improved, highlighting the students' satisfaction with the platform, and the benefits they gained; especially, a better integration of their practical knowledge, an improvement of their communication skills, decision-making capabilities and clinical reasoning, and an increase in their confidence in their skills.

With more accessible access to such platforms, we recommend that virtual patient simulators become an integral part of the medical teaching curriculum.

SUMMARIES

Abstract

Introduction:

Medical education is an ever evolving matter, adapting to its context and the technologies around it. With the democratisation of virtual reality, it stands to reason to see more and more virtual patients simulators appear around us. The Body Interact Virtual Patient Simulator is one of them, an easily accessible online serious game that enables medical students and professionals to practise their clinical reasoning and decision-making skills in a safe controlled environment. The VPS provides various clinical scenarii, pertaining to multiple specialties, during which the user can take charge of a virtual patient's care from the medical history and primary assessment to the treatment plan. After the completion of the scenario, it offers helpful feedback on the user's performance.

Our study's aim was to determine the impact of the Body Interact Virtual Patient Simulator on clinical reasoning and decision-making amongst medical students.

Means and methods:

122 students were given the opportunity to try the platform. They completed three scenarii, after filling a primary questionnaire assessing their opinions of their current learning process, then they filled another questionnaire examining their opinions on their learning process with the influence of the Body Interact VPS.

Results:

Results were promising, demonstrating a statistically significant improvement of almost all the items, especially the ones concerning their clinical reasoning and decision-making skills, thereby showcasing the positive impact of the Body Interact VPS.

Discussion:

Playing games is nothing new in human history, it is perhaps one of the most natural, instinctive human behaviours. And the use of games for serious purposes has been used across

all domains, for decades. Yet their use as an integral part of the medical teaching curriculum is still lacking. Our study, as well as several others across the world, demonstrate how crucial they could be. They provide a safe environment for students to practise their skills without any risk or harm, they enable them to repeat the scenarii until their goal is achieved, and they offer a fun way to engage students and keep them motivated during long, substantial studies. By making students active learners, we make them responsible for their learning, ultimately making them better students and , hopefully, better doctors in the future.

Conclusion:

Our suggestion after this study is for the use of Virtual Patient Simulators to become a standard in medical education, in our faculty, our teaching hospital, and the rest of the medical community.

Résumé

Introduction:

L'éducation médicale est constamment en cours d'évolution, s'adaptant aux demandes qui la régissent et à la technologie qui l'entoure. Avec la démocratisation de la réalité virtuelle, on remarque la naissance de plus en plus de plateformes de Simulateurs de Patients Virtuels, entre autres le Body Interact Virtual Patient Simulator. C'est une plateforme accessible en ligne, créée pour donner aux étudiants en médecine et professionnels de santé l'occasion de pratiquer leur raisonnement clinique et décisions diagnostiques et thérapeutiques en toute tranquillité. Le Body Interact VPS offre des scénarios cliniques de multiples spécialités, où l'utilisateur, après un briefing sur les renseignements cliniques du Patient Virtuel, peut prendre en charge ledit patient de l'étape de l'anamnèse à l'étape thérapeutique. Après la conclusion du scénario, l'utilisateur a accès à un feedback sur sa performance et ses éventuelles erreurs, lui permettant d'identifier ses lacunes.

Notre étude avait pour but de démontrer l'impact du Body Interact Virtual Patient Simulator sur le raisonnement clinique et la prise de décision chez les étudiants en médecine.

Matériels et méthodes:

Pour cela, 122 étudiants ont pris part à l'étude en complétant 3 scénarios cliniques sur la plateforme de simulations. Ils ont rempli deux formulaires, un avant leur expérience avec Body Interact, et un après, pour évaluer leur niveau de satisfaction avec la plateforme et leur perception à propos des avantages et inconvénients de la plateforme concernant leur processus d'enseignement et leurs compétences personnelles.

Résultats:

Les résultats se sont avérés positifs. Les attentes des étudiants quant à la plateforme étaient élevées, et leurs scores en réponse aux questionnaires se sont améliorés d'une manière statistiquement significative pour la grande majorité des questions, prouvant l'impact positif du

Body Interact VPS sur leurs compétences personnelles, notamment leur raisonnement clinique et leur prise de décision. Ces résultats sont en accord avec la littérature existante à ce sujet, qui démontre que la simulation dans l'enseignement médicale aide à développer les compétences personnelles et pratiques des futurs médecins.

Discussion:

Le Body Interact VPS s'inscrit dans une longue histoire de jeux sérieux, où l'objectif des jeux est détourné de l'amusement à l'enseignement. Ces jeux permettent de motiver les étudiants d'une manière divertissante, et de les transformer en apprenants actifs. Outre le degré de motivation qu'ils entraînent, ils permettent aux étudiants de répéter les scénarios autant que nécessaire et leur offrent un espace sécurisé pour commettre leurs erreurs sans risque aucun pour les patients, jusqu'à ce qu'ils maîtrisent leurs connaissances.

Conclusion:

Au terme de notre étude, nous recommandons l'intégration de l'enseignement à travers des simulateurs de patients virtuels dans le cursus médical.

ملخـص

مقدمــة:

يشهد التعليم الطبي تطورا مستمرا ويتأقلم مع المتطلبات التي تنظمه والتكنولوجيا التي تحيط به .ففي خضم تعميم الواقع الافتراضي نسجل إحداث منصات أجهزة محاكاة المرضى الافتراضيين بشكل متزايد من بينها جهاز المحاكاة المسمى Body Interact Virtual Patient Simulator. يمكن الولوج لهذه المنصة عبر الإنترنت حيث تم إحداثها من أجل منح طلبة الطب و مهنييالصحة فرصة لممارسة تعليلهم السريري وقرارات التشخيص والعلاج بكل طمأنينة .يعطي Body Interact Virtual Patient Simulator افتراضات سريرية تهم اختصاصات عدة حيث يمكن للمستعمل بعد الإحاطة بشأن المعلومات السريرية للمريض الافتراضي رعاية المريض المذكور من مرحلة التأريخ الطبي إلى مرحلة العلاج .بعد إنهاء الافتراض، يحق للمستعمل الولوج لتقييم أدائه وأخطائه المحتملة مما يمكنه من تصحيح هفواته.

تهدف دراستنا إلى تبيان تأثير Body Interact Virtual Patient Simulatorعلى التعليل السريري واتخاذ القرار لدى طلبة الطب.

الأدوات والطرق

في هذا الصدد، شارك 122طالب في الدراسة من خلال إكمال ثلاث سيناريوهات سريرية بمنصة المحاكاة .لقد عبئوا استمارتين، واحدة قبل تجربتهم مع Body Interact و أخرى بعدها، من أجل تقييم مستوى الرضا الخاص بهم مع المنصة وفهمهم مزايا المنصة وعيوبها فيما يتعلق بعملية التعليم الخاصة بهم وكفاءاتهم الشخصية.

النتائــج:

تبين أن النتائج إيجابية .لقد كانت انتظارات الطلبة بخصوص المنصة عالية وشهدت نقاط الجواب على الاستمارات تحسنا بشكل مهم من حيث الإحصائيات بالنسبة للأغلبية الكبيرة من

الأسئلة مما يثبت التأثير الإيجابي لـ Body Interact VPS على مؤهلاتهم الشخصية لاسيما تعليلهم السريري و إتخاد قراراتهم.تعتبر هذه النتائج متسقة مع الأبحاث الموجودة في هذا الصدد والتي تبين بأن المحاكاة في التعليم الطبي تساعد على تطوير المهارات الشخصية للأطباء المستقبليين وممارساتهم.

المناقشــة:

يندرج Body Interact VPSفي إطار ألعاب جدية حيث تم تحوير المقصود من الألعاب من ما هو ترفيهي إلى ما هو تعليمي .تمكن هذه الألعاب من تحفيز الطلبة بشكل مسلي وتحويلهم لمتعلمين نشطين .علاوة على درجة التحفيز التي تترتب عنهم فإنهماتمكن الطلبة من تكرار السيناريوهات كلما دعت الضرورة ذلك وتمنحهم فضاء آمنا من أجل ارتكاب أخطاء دون أي خطر يذكر بالنسبة للمرضى إلى غاية التحكم في معارفهم.

الخلاصـة:

بانتهاء دراستنا، نوصي بإدماج التعليم بواسطة أجهزة محاكاة مرضى افتراضيين في مسار التعليم الطبي.

APPENDIXES

Appendix 1: Questionnaire

Gender :

Course year :

Pre-Session with Body Interact Questionnaire (user)

Section 1: On a scale from 1 to 7 (1 = totally disagree and 7 = totally agree), rate each of the following items regarding your current individual learning process
U0.1. I am able to organise my reasoning.
U0.2. My studies are mainly focused on theory.
U0.3. My studies balance theoretical studies with the practical application of knowledge.
U0.4. My learning process allows for the suitable development of my communication skills.
U0.5. My learning process allows me to build my confidence (in my knowledge and in the decision-making process).
U0.6. My learning process allows me to develop my skills in group management and conflict management.
U0.7. My clinical experience is appropriate for my knowledge level.
U0.8. My simulation experience is appropriate for my knowledge level.

Section 2: On a scale from 1 to 7 (1 = totally disagree and 7 = totally agree), rate each of the following items regarding your current pedagogical process
U0.9. In my course the content is well integrated and connected with each other.
U0.10. In my course there are opportunities to apply new learning to practical clinical cases.
U0.11. In my course we have the opportunity to participate in clinical simulations.
U0.12. In my course there is adequate training in communication techniques.
U0.13. In my course there is discussion/debate of clinical decisions in a controlled learning environment.
U0.14. My course helps me build the personal confidence necessary to function as a future professional.
U0.15. I consider the teaching methods in my course appropriate.

Section 3: On a scale from 1 to 7 (1 = low expectation and 7 = high expectation), rate each of the following items regarding your expectations about the use of the Body Interact simulator
U0.16. Expectations regarding the use of Body Interact as a new learning tool.
U0.17. Expectations regarding the use of Body Interact as a technological resource for learning.
U0.18. Expectations regarding using Body Interact as a simulator.

Section 4: On a scale from 1 to 7 (1 = totally disagree and 7 = totally agree), rate each of the following items regarding your learning experience expectations with the Body Interact simulator
U0.19. I expect that Body Interact will help to fill in the learning gaps in the teaching process.
U0.20. I expect that Body Interact will help to fill in the individual gaps in my current learning.
U0.21. I expect that Body Interact will provide real feedback on my learning.
U0.22. I expect that Body Interact will help me identify individual weaknesses in my competencies.
U0.23. I expect that Body Interact will give me clinical experience (through simulation).
U0.24. I expect that Body Interact will validate the competencies I have already acquired (through simulation).
U0.25. I expect that Body Interact will help me practice decision-making strategies.
U0.26. I expect that Body Interact will help me to transform clinical decision-making errors into a constructive learning process.
U0.27. I expect that Body Interact will become an important learning tool.

Post-Session with Body Interact Questionnaire (user)

Section 1: On a scale from 1 to 7 (1 = totally disagree and 7 = totally agree), rate each of the following items regarding your current individual learning process after your experience with the Body Interact simulator
U1.1. I am able to organise my reasoning.
U1.2. My studies are mainly focused on theory.
U1.3. My studies balance theoretical studies with the practical application of knowledge.
U1.4. My learning process allows for the suitable development of my communication skills.
U1.5. My learning process allows me to build my confidence (in my knowledge and in the decision-making process).
U1.6. My learning process allows me to develop my skills in group management and conflict management.

Section 2: On a scale from 1 to 7 (1 = totally disagree and 7 = totally agree), rate each of the following items regarding any gaps in your current pedagogical process after your experience with the Body Interact simulator
U1.7. In my course the content is well integrated and connected with each other.
U1.8. In my course there are opportunities to apply new learning to practical clinical cases.
U1.9. In my course we have the opportunity to participate in clinical simulations.
U1.10. In my course there is adequate training in communication techniques.

U1.11. In my course there is discussion/debate of clinical decisions in a controlled learning environment.
U1.12. My course helps me build the personal confidence necessary to function as a future professional.
U1.13. I consider the teaching methods in my course appropriate.

Section 3: On a scale from 1 to 7 (1 = low satisfaction and 7 = high satisfaction), rate each of the following items regarding your satisfaction with the use of the Body Interact simulator
U1.14. Satisfaction level regarding the use of Body Interact as a new learning tool.
U1.15. Satisfaction level regarding the use of Body Interact as a technological resource for learning.
U1.16. Satisfaction level regarding the use of the Body Interact as a simulator.

Section 4: On a scale from 1 to 7 (1 = totally disagree and 7 = totally agree), rate each of the following items regarding your learning experience with the Body Interact simulator
U1.17. Body Interact allowed me to bridge the learning gaps in the teaching process.
U1.18. Body Interact helped me to bridge the learning gaps in my own learning.
U1.19. Body Interact provided real feedback on my learning.
U1.20. Body Interact enabled me to identify individual weaknesses in my competencies.
U1.21. Body Interact gave me clinical experience (through simulation).
U1.22. Body Interact validates the competencies I have already acquired.

U1.23. Body Interact helped me practice decision-making strategies.
U1.24. Body Interact turned clinical decision-making errors into a constructive learning process.
U1.25. Body Interact is an important learning tool.

Section 5: On a scale from 1 to 7 (1 = not important and 7 = highly important), rate each of the following items regarding the level of importance you attach to training that uses simulation with virtual patients
U1.26. Development of decision-making skills.
U1.27. Development of independent learning skills.
U1.28. Simulation training.
U1.29. Organisation of reasoning and critical thinking.
U1.30. Constructive feedback.
U1.31. Ability to repeat clinical cases.
U1.32. Complexity level of health conditions and clinical cases.

Appendix 2: Descriptive results

Pre-session questionnaire:

Current individual learning process (Cronbach's alpha = 0.760):

Question	Mean	Standard deviation	Item-test correlation	If item dropped: Cronbach's alpha
U0.1 I am able to organize my reasoning.	4.62	1.332	0.536	0.719
U0.2 My studies are mainly focused on theory.	4.82	1.559	-0.227	0.888
U0.3 My studies balance theoretical studies with the practical application of knowledge	4.39	1.608	0.591	0.700
U0.4 My learning process allows for suitable development of my communication skills.	4.22	1.524	0.762	0.653
U0.5 My learning process allows me to build my confidence (in my knowledge and in the decision-making process).	4.47	1.682	0.780	0.639
U0.6 My learning process allows me to develop my skills in group management and conflict management.	4.33	1.593	0.783	0.643
U0.7 My clinical experience is appropriate for my knowledge level.	4.25	1.475	0.474	0.914
U0.8 My simulation experience is appropriate for my knowledge level.	4.56	1.696	0.528	0.914

Current pedagogical process (Cronbach's alpha = 0.870) :

Question	Mean	Standard deviation	Item-test correlation	If item dropped: Cronbach's alpha
U0.9 In my course the content is well integrated and connected with each other.	4.32	1.422	0.611	0.858
U0.10 In my course there are opportunities to apply new learning to practical clinical cases.	4.62	1.602	0.639	0.854
U0.11 In my course we have the opportunity to participate in clinical simulations.	4.73	1.676	0.535	0.870
U0.12 In my course there is adequate training in communication techniques.	3.83	1.514	0.734	0.841
U0.13 In my course there is discussion/debate of clinical decisions in a controlled learning environment.	4.41	1.503	0.674	0.849
U0.14 My course helps me build the personal confidence necessary to function as a future professional.	4.30	1.514	0.670	0.850
U0.15 I consider the teaching methods in my course appropriate.	4.07	1.368	0.696	0.848

Expectations about the use of the Body Interact VPS (Cronbach's alpha = 0.899):

Question	Mean	Standard deviation	Item-test correlation	If item dropped: Cronbach's alpha
U0.16 Expectations regarding the use of Body Interact as a new learning tool.	6.07	1.214	0.806	0.852
U0.17 Expectations regarding the use of Body Interact as a technological resource for learning.	6.11	1.130	0.814	0.844
U0.18 Expectations regarding using Body Interact as a simulator.	6.18	1.099	0.784	0.870

Learning experience expectations with the Body Interact VPS (Cronbach's alpha = 0.949):

Question	Mean	Standard deviation	Item-test correlation	If item dropped: Cronbach's alpha
U0.19 I expect that Body Interact will help to fill in the learning gaps in the teaching process.	6.16	1.068	0.791	0.944
U0.20 I expect that Body Interact will help to fill in the individual gaps in my current learning.	6.16	0.988	0.851	0.941
U0.21 I expect that Body Interact will provide real feedback on my learning.	6.31	0.891	0.819	0.943
U0.22 I expect that Body Interact will help me identify individual weaknesses in my competencies.	6.15	1.088	0.755	0.946
U0.23 I expect that Body Interact will give me clinical experience (through simulation).	6.28	0.884	0.756	0.946
U0.24 I expect that Body Interact will validate the competencies I have already acquired (through simulation).	6.13	1.060	0.789	0.944
U0.25 I expect that Body Interact will help me practice decision-making strategies.	6.17	1.002	0.829	0.942
U0.26 I expect that Body Interact will help me to transform clinical decision-making errors into a constructive learning process.	6.27	0.979	0.832	0.942
U0.27 I expect that Body Interact will become an important learning tool.	6.46	0.892	0.796	0.944

Post-session questionnaire:

Current individual learning process after the experience with the Body Interact simulator

Question	Mean	Standard Deviation
U1.1. I am able to organise my reasoning.	5.19	1.363
U1.2. My studies are mainly focused on theory.	4.73	1.601
U1.3. My studies balance theoretical studies with the practical application of knowledge.	4.85	1.458
U1.4. My learning process allows for suitable development of my communication skills.	4.85	1.441
U1.5. My learning process allows me to build my confidence (in my knowledge and in the decision-making process).management.	4.91	1.532
U1.6. My learning process allows me to develop my skills in group management and conflict	4.96	1.561

Gaps in the current pedagogical process after the experience with the Body Interact simulator

Question	Mean	Standard deviation
U1.7. In my course the content is well integrated and connected with each other.	5.02	1.357
U1.8. In my course there are opportunities to apply new learning to practical clinical cases.	5.19	1.416
U1.9. In my course we have the opportunity to participate in clinical simulations.	5.39	1.502
U1.10. In my course there is adequate training in communication techniques.	4.76	1.691
U1.11. In my course there is discussion/debate of clinical decisions in a controlled learning environment.	4.94	1.517
U1.12. My course helps me build the personal confidence necessary to function as a future professional.	4.98	1.595
U1.13. I consider the teaching methods in my course appropriate.	4.98	1.587

Satisfaction with the use of the Body Interact simulator

Question	Mean	Standard Deviation
U1.14. Satisfaction level regarding the use of Body Interact as a new learning tool.	6.54	0.694
U1.15. Satisfaction level regarding the use of Body Interact as a technological resource for learning.	6.53	0.773
U1.16. Satisfaction level regarding the use of the Body Interact as a simulator.	6.64	0.617

Learning experience with the Body Interact simulator

Question	Mean	Standard deviation
U1.17. Body Interact allowed me to bridge the learning gaps in the teaching process.	6.34	0.811
U1.18. Body Interact helped me to bridge the learning gaps in my own learning.	6.42	0.770
U1.19. Body Interact provided real feedback on my learning.	6.52	0.730
U1.20. Body Interact enabled me to identify individual weaknesses in my competencies.	6.51	0.707
U1.21. Body Interact gave me clinical experience (through simulation).	6.57	0.667
U1.22. Body Interact validates the competencies I have already acquired.	6.39	0.858
U1.23. Body Interact helped me practice decision-making strategies.	6.43	0.771
U1.24. Body Interact turned clinical decision-making errors into a constructive learning process.	6.46	0.794
U1.25. Body Interact is an important learning tool.	6.66	0.638

The level of importance you attach to training that uses simulation with virtual patients

Question	Mean	Standard deviation
U1.26. Development of decision-making skills.	6.45	0.694
U1.27. Development of independent learning skills.	6.43	0.692
U1.28. Simulation training.	6.58	0.690
U1.29. Organisation of reasoning and critical thinking.	6.54	0.706
U1.30. Constructive feedback.	6.52	0.683
U1.31. Ability to repeat clinical cases.	6.48	0.763
U1.32. Complexity level of health conditions and clinical cases.	6.45	0.728

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قسم الطبيب

أقْسِم بالله العَظِيم

أن أراقبَ الله في مِهْنَتِي.

وأن أصُونَ حياة الإنسان في كآفّةِ أطوَارهَا في كل الظروف والأحَوال باذلة وسْعِي في إنقاذها مِن الهَلاكِ والمرَضِ والألَم والقَلَق.

وأن أحفَظَ لِلنَاسِ كرَامَتهُم، وأسْتر عَوْرَتهُم، وأكتمَ سِرَّهُمْ.

وأن أكونَ عَلى الدوَام من وسائِل رحمة الله، باذلة رِعَايَتي الطبية للقريب والبعيد،للصالح والطالح، والصديق والعدو.

وأن أثابر على طلب العلم، وأسَخِّرَه لِنَفْعِ الإنْسَان لا لأذَاه.

وأن أُوَقّرَ مَن عَلَّمَني، وأُعَلّمَ مَن يَصْغرَني، وأكون أختاً لِكُلّ زَميل في المِهنَةِ الطِّبِّيَة مُتعَاونِين عَلى البرِّ والتقوى.

وأن تكون حياتي مِصْدَاق إيمَاني في سِرّي وَعَلانيَتي،نَقِيَّة مِمّا يُشينهَا تجَاهَ الله وَرَسُولِهِ وَالمؤمِنين.

والله على ما أقول شهيد

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سنة 2022 أطروحة رقم 091

تقييم برنامج تدريب التعليل السريري باستخدام ألعاب جدية

الأطروحة

قدمت ونوقشت علانية 2022/04/04

من طرف

الآنسة ياسمين فوالي

المزدادة في 21أكتوبر 1995بمراكش

لنيل شهادة الدكتوراه في الطب

الكلمات الأساسية :

طلبة الطب –تعليل سريري –ألعاب جدية –مرضى افتراضيين

اللجنة

السيد	أ.غ. الأديب استاذ في التخدير و الانعاش	الرئيس
السيد	ع. هاشمي أستاذ في الانعاش الطبي	المشرف
السيدة	م. صباني أستاذة مبرزة في الطب الوقائي و الصحة العامة	الحكام
السيد	ح. رباحي أستاذ مبرز في التخدير و الانعاش	