What is the students’ opinion about using scenarios with manikins and Simulated Patients in undergraduate medical education?

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Abstract

Background

Medical simulation has turned to be a well-developed educational technique at a postgraduate level, including, residency programs and continuing vocational training. However, its applicability has still not been clearly defined when providing education to undergraduate medical students.

Objective

The aim of the study was to determine the opinion of undergraduate medical students about the effectiveness of manikin-based and SP-based high-fidelity scenarios for learning clinical objectives. This is considered important in a discussion about the systematic implementation of SP-based simulation in undergraduate medical education.

Methods

A mixed methods approach was used to collect the evidence. Triangulation included a literature review, semi-structured interviews and a questionnaire survey. The study was conducted among 6th-year medical students who experienced various clinical educational techniques.

Results

Students preferred SP-based medical simulation, as they perceived it to be more life-like than with a manikin. It was also reported to be more effective for developing non-technical skills, including communication and interpersonal skills. However, when technical skills were taken into consideration, for instance, performing invasive and non-invasive procedures, students opted for using manikins or a combination of both.

Conclusions

The study results suggest that both manikins and SPs should be included in the medical curriculum from the beginning of students’ clinical experience. A combination of both modalities would ensure acquisition of skills, both technical and non-technical, required from contemporary health care professionals.

The Investigation And Methods

The purpose of the investigation was to establish the views of medical undergraduates in Lublin
Medical University about their experience of manikins and SPs. This was achieved by semi-structured interview followed by a semi-structured questionnaire-survey. The population was Year Six medical students, and ethical approval was granted by the Medical University of Lublin Bioethics Committee.

**Semi-structured interview**

The key themes arising from the literature review and the thinking of the authors were, realism of the clinical experience, effectiveness in trauma training, medical simulation, manikins and simulated patients. Following the academic principles used for conducting interviews in the ‘Handbook of Practical Program Evaluation,’ [21] a series of open questions were prepared. An independent psychologist, with experience in interview techniques, who was unknown to the students, and not connected with the course, was commissioned to conduct the interviews, as a safeguard against introducing bias. The questions are reported in Appendix 1.

The sample population was Year Six medical students who had experienced all possible methods of learning clinical objectives, including high-fidelity simulation scenarios with a manikin and an SP and practical clinical classes with real patients. The selection of students for the interview stage was made by open invitation to clinical students, which was announced on the University main webpage and the web page of the Student Research Association for Medical Simulation at the Medical University of Lublin. The registration was open for two weeks and attracted 14 candidates. The method of registration allowed the participants to remain anonymous to the author. The neutral psychologist made the arrangements for completing the interviews. Interviews were conducted until the point of saturation of information was reached.

Interviews were conducted in a quiet room, away from the main teaching areas and considered to be “a neutral place”. At the beginning of each interview, the participant was provided with a copy of the study description, its aim and methods, and assurance of anonymity. They were given an opportunity to withdraw if they wished. All participating students signed an informed consent form, which gave consent both to be involved in the research and to be recorded by audio. There was no pressure for time, and the participants were able to think about their answers before speaking, and were given the opportunity to review, modify or change anything they said during the interview. They were informed
that the recordings, and transcripts would be destroyed after the research report was accepted for publication.

A thematic analysis of the text was undertaken by listing the points in an excel spread-sheet and completing a frequency count. The analysis was not a search for meaning, as in other humanistic inquiries, but as a means of establishing the core themes for the survey that followed.

The questionnaire-survey

The questionnaire [See Appendix 2] was constructed to provide a more detailed analysis of the opinions found in the semi-structured interviews, with respect to the effectiveness of learning clinical objectives using manikin-based and SP-based simulations and to elicit further information about demographics and characteristics of the study group. The paper-based survey was distributed and collected by the psychologist in large group sessions in the normal timetable.

The academic principles used for conducting the survey were set out in Greenhalgh’s ‘Selecting, designing, and developing your questionnaire’ [22]. It consisted of 5 parts and 66 questions. The first part of the survey included demographics questions used to collect information about the characteristics of the study group.

In the second part, the students were asked about their experience with manikin- and SP-based simulations. Students could mark more than one answer and their responses were organised using multiple dichotomies (1 – yes; 0 – no).

The third part of the survey (questions 5 to 26, 28 to 52, 54 to 56 investigated students’ opinion about the effectiveness of manikin– and SP-based simulation training when learning clinical objectives by means of mirror questions. The questions were grouped in two categories, learning clinical objectives and features/limitations of a method vs. realism.

The 4-point Likert scale was used in order to avoid neutral or ‘no opinion’ type of answers that might not produce the expected outcome of the survey [23]. The answers included numerical values from 1–4, which, according to the instruction provided in the survey, were translated in the following way: 1 = definitely no; 2 = rather no; 3 = rather yes; 4 – definitely yes. Students could mark only one answer.

The sample population was Year Six medical students who had experienced all possible methods of
learning clinical objectives, including high-fidelity simulation scenarios with a manikin and an SP and practical clinical classes with real patients. The on-line survey was completed by 273 out of 383 sixth-year students in the medical programme. The sample was statistically significant.

In line with the Faculty’s ethical approval, a written explanation was given to explain the nature and purpose of the study. It was made clear that participation in the survey was voluntary and anonymous.

Analysis And Results Of The Questionnaire

The first part of the survey included demographics questions used to collect information about the characteristics of the study group. The data were described by means of descriptive statistics and normality of age distribution was verified with the Shapiro-Wilk’s W test.

In the second part, the analysis of students’ answers to questions 1–4 was presented by means of descriptive statistics. Students’ selection of courses, which provided them with valuable simulation experience using manikins and SPs, were calculated percentage wise. Students could mark more than one answer and their responses were organised using multiple dichotomies (1 - yes; 0 - no).

In the third part of the survey (questions 5 to 26, 28 to 52, 54 to 56) the results to the questions were compared using the nonparametric Wilcoxon matched-pairs test for ordinal-scale variables. Marked tests were significant at $p < 0.05$.

The results to yes-no question nr 27 and 53, asking students if using one modality or another influences their sense of caution, were evaluated with McNemar’s test.

The results to questions 57 to 65 were analysed by means of descriptive statistics. Students’ selection of teaching modalities, which provided them with the most effective way of learning particular clinical objectives, was calculated as a percentage. Students could mark only one answer for questions 57–63. For 64 and 65, students could mark more than one answer and their responses were organised using multiple dichotomies (1 - yes; 0 - no). Answers provided to question 66 were evaluated with descriptive statistics.

Statistical analysis

All data were analysed using the software STATISTICA Version 12 (StatSoft Inc., Tulsa, Oklahoma,
USA). The values of the effect size and power of the tests were calculated using G*Power software [24, 25]. The internal consistency of the questionnaires was calculated and expressed as Cronbach’s alpha [26]. The comparisons were computed with Statistic Calculator (StatPac Inc., Northfield, Minnesota, USA).

Results Of The Questionnaire-survey
Characteristics of the study group
Out of 273 students who took part in the survey, 165 (60%) were women and 108 (40%) were men with a median age of 25 years (range 23 to 33 years).

[Table 1 near here]

| Participants          |
|-----------------------|
| n = 273               |

| GENDER | n, (%) |          |          |
|--------|--------|----------|----------|
| Men    | 108    | (40)     |          |
| Women  | 165    | (60)     |          |

| AGE     | Median | Minimum | Maximum |
|---------|--------|---------|---------|
|         | 25.00  | 23.00   | 33.00   |

Lower and upper quartile 25%-75%

24.00–26.00

The interpretation of statistical differences is presented below. Data in Table 2 confirms that most of the results are statistically significant, except for communication in team (p = 0.182).

Table 2
Analysis of students’ opinion about the effectiveness of manikin–based and SP-based simulation scenarios for learning particular clinical objectives

| Procedures                                         | Percent | t     | df  | P    |
|----------------------------------------------------|---------|-------|-----|------|
| Checking arterial blood pressure                   | 25      | 77    | 9.54| 272  |
| Patient monitoring                                 | 68      | 40    | 4.62| 272  |
| Physical examination                               | 23      | 74    | 10.00| 272  |
| Taking patient history                             | 12      | 86    | 18.59| 272  |
| Auscultation of the rate and lungs                 | 27      | 68    | 7.66| 272  |
| Communication with patient and his/her family      | 7       | 84    | 22.59| 272  |
| Learning reaction in response to particular symptoms| 27     | 59    | 6.08| 272  |
| Communication in team                              | 45      | 53    | 1.34| 272  |
|                                                    |         |       |     | 0.182|
Analysis of students’ experience with manikin-based and SP-based simulation training (questions 1–4)
All respondents experienced manikin-based and SP-based simulation training. Answers to questions 2 and 4 included lists of courses, in accordance to the curriculum, realized manikin-based and SP-based high-fidelity simulation scenarios. An ‘other’ answer option was added in the case students experienced such training during any extracurricular activities. Students could mark more than one answer and their responses were organised using multiple dichotomies (1 - yes; 0 - no).

As far as SP-based simulation was concerned, students most frequently pointed to Infectious diseases (69%; 189 answers), Basic Clinical Skills (45%; 124 answers) and Elderly Medicine (42%; 116 answers), as to the courses that provided them with the biggest experience with this modality. Ninety-four students marked ‘other’ answer option, and some provided names of the courses: Integrated Clinical Skills (3%, 3 answers), Integrated Simulation-based Clinical Training (7%, 8 answers) and Family Medicine (3%; 3 answers).

The students received the biggest SP-based simulation experience during Infectious Diseases (69%).

With respect to manikin-based simulation, students most frequently pointed to Basic Clinical Skills (94%; 257 answers), Thoracic Surgery (88%, 241 answers) and Elderly Medicine (85%; 231 answers), as the courses that provided them with the biggest experience with this modality. A high proportion of students’ answers (74%) was also noted for courses like Infectious Diseases, Gynaecology, Anaesthesiology and Integrated Clinical Skills. 19 students marked ‘other’ answer option – 2 students (11%) pointed to Integrated Simulation-based Clinical Training and 1 student (5%) pointed to Family Medicine. 16 students (84%) did not provide any further details. The students received the biggest manikin-based simulation experience during Basic Clinical Skills (94%).

According to the accumulated data, students learnt clinical objectives by means of high-fidelity simulation more often with manikins than with simulated patients. Their experience with high-fidelity SP-based medical simulation appeared to be most advanced in Infectious Diseases course. It is worth
noting, however, that the second most frequently marked course was Basic Clinical Skills, during which, SPs were not employed to support the educational process. Nevertheless, students might have taken learning medical procedures with colleagues or with a teacher, for instance, pulse taking, as a form of this modality. Basic Clinical Skills was also the course during which students received the biggest manikin-based simulation practice.

Analysis of students’ opinion about the effectiveness of manikin-based and SP-based simulation scenarios in clinical education (questions 5 to 26, 28 to 52, 54 to 56)

For the purpose of the analysis, the questions were grouped in two categories: learning clinical objectives and features/limitations of a method vs. realism. They addressed the same aspects of the learning process when using either a manikin or an SP to observe, if, with the increase of values in the scale presenting students’ opinion about the effectiveness of high-fidelity SP-based simulations, the values reflecting their opinion about the effectiveness of manikin-based simulations decrease. A mean percentage was calculated separately for each of possible answers (definitely not, probably not, probably yes, definitely yes), each of the questions in a particular group (learning clinical objectives and features/limitations of a method vs. realism), and separately for the questions referring to using manikins and SPs. The data were presented in Figs. 3 and 4.

[Figure 3 near here]

Figure 3 provides a distribution of students’ opinion about the effectiveness of manikin-based and SP-based high fidelity simulation scenarios for learning clinical objectives. The analysis revealed that answers ‘definitely not’ (27%) and ‘probably not’ (29%) were most prevalent for questions referring to the effectiveness of learning clinical objectives with the use of a manikin. On the other hand, the effectiveness of learning clinical objectives with the use of an SP was confirmed by almost 70% of the students (28% of ‘probably yes’ and 40% of ‘definitely yes’ answers). By this analysis, it can be stated, that students’ opinions about the effectiveness of learning clinical objectives during manikin- and SP-based high fidelity simulation scenarios are quite contradictory.

[Figure 4 near here]

Figure 4 provides a distribution of students’ opinion about the influence of features and limitations of
the manikin-based and SP-based high fidelity simulation scenarios on the sense of realism of the learning process.

According to the results, student’s opinions about the influence of features and limitations of manikin-based simulations on the sense of realism of the learning process were divided, as ‘definitely not’ constituted 20% of their answers and ‘definitely yes’ was marked by 37% of the students. On the other hand, almost three quarters of respondents (35% of ‘probably yes’ answers; 37% of ‘definitely yes’ answers) confirmed that the features and limitations of SP-based simulation scenarios affect the sense of realism of the learning process.

Although the students’ opinion appeared to be contradictory when comparing the influence of manikin-based and SP-based simulation scenarios on the sense of realism of the learning process, their answers were less diversified than in the previous category about learning clinical objectives.

Having established the students’ general views, a more detailed comparative analysis of students’ answers to questions, addressing the same aspects of clinical education with respect to each modality, was conducted (Table 3).

### Table 3
Comparison of students’ answers to questions in the category ‘learning clinical objectives’

| Area of testing                                                                 | Classes with a manikin | Classes with an SP | Z value** | P value** |
|---------------------------------------------------------------------------------|------------------------|---------------------|-----------|-----------|
| Facilitating of the work on eliminating mistakes when performing medical procedures | 3.00; 2.00–4.00; 1.00–4.00 | 2.00; 2.00–3.00; 1.00–4.00 | 4.449     | p < 0.001 |
| Min – Max n = 200*                                                             |                        |                     |           |           |
| Facilitating of the development of effective teamwork                           | 3.00; 2.00–4.00; 1.00–4.00 | 2.00; 2.00–3.00; 1.00–4.00 | 2.657     | 0.008     |
| Median; lower and upper quartile 25%-75%                                       |                        |                     |           |           |
| Min - Max n = 194*                                                             |                        |                     |           |           |
| Facilitating of the development of patient-doctors communication skills         | 1.00; 1.00–2.00; 1.00–4.00 | 4.00; 3.00–4.00; 1.00–4.00 | 12.505    | p < 0.001 |
| Median; lower and upper quartile 25%-75%                                       |                        |                     |           |           |
| Min - Max n = 229*                                                             |                        |                     |           |           |
| Possibility | Median; lower and upper quartile | Min – Max | n | p |
|-------------|---------------------------------|----------|---|---|
| to learn different diagnostic and therapeutic procedures | 3.00; 2.00; | 1.00-4.00; 1.00-2.00; | 216* | 0.001 |
| to learn rare and pathological cases | 3.00; 2.00; | 1.00-4.00; 1.00-2.00; | 198* | 0.001 |
| Facilitating of the development of technical skills | 4.00; 2.00; | 1.00-4.00; 1.00-2.00; | 229* | 0.001 |
| Facilitating of the development of patient history taking skills | 2.00; 4.00; | 1.00-2.00; 1.00-4.00; | 227* | 0.001 |
| Support of the professional behaviour when performing medical procedures | 2.00; 4.00; | 1.00-2.00; 1.00-4.00; | 223* | 0.001 |
| Facilitating of the understanding of patient's feelings during physical examination | 1.00; 4.00; | 1.00-2.00; 1.00-4.00; | 234* | 0.001 |
| Facilitating of the understanding of patient's rights | 2.00; 4.00; | 1.00-2.00; 1.00-4.00; | 235* | 0.001 |
| Facilitating of the development of a doctor-patient relationship | 1.00; 4.00; | 1.00-2.00; 1.00-4.00; | 235* | 0.001 |
The data suggests that, students’ opinions about the effectiveness of manikin–based and SP-based simulation scenarios in clinical education are statistically different. The preference is for learning non-technical skills with an SP rather than with a manikin. Non-technical skills in the category ‘learning clinical objectives’ included: understanding the feelings of a patient during physical examination, doctor-patient communication and rapport or taking patient history. However, students considered manikin-based simulation training more useful for learning technical skills, for instance, error management when performing medical procedures, developing teamwork skills, increased possibility of learning rare and pathological cases and for learning different diagnostic and therapeutic procedures.

To summarise, students preferred learning non-technical skills with an SP and technical skills with a manikin.

Table 4
Comparison of students’ answers to questions in the category ‘Features/limitations of a method vs. realism’

| Area of testing                                      | Classes with manikin | Classes with SP | Z value** | P value** |
|------------------------------------------------------|----------------------|-----------------|-----------|-----------|
| Limitation of the sense of realism of a particular   | 3.00; 3.00–4.00      | 2.00; 1.00–200  | 9.196     | p < 0.001 |
| clinical case Median; lower and upper quartile       | 1.00–4.00            | 1.00–4.00       |           |           |
| 25%-75% Min – Max n = 202*                           |                      |                 |           |           |
| Artificiality of the method                          | 3.00; 3.00–4.00      | 2.00; 1.00–2.00 | 11.098    | p < 0.001 |
|                                                      |                      |                 |           |           |
|                                                                 | Median; lower and upper quartile | Min – Max | n = 207* | p-value | p-value  |
|------------------------------------------------------------------|----------------------------------|-----------|----------|---------|----------|
| The influence of the scope of the patient's responsiveness on the fluency of interaction and decision making process | 3.00; 2.00–3.50 | 1.00–4.00 | 0.137    | 0.891   |          |
| Limitation of the scope of procedures available to be performed | 3.00; 2.00–4.00 | 1.00–4.00 | 10.908   | p < 0.001 |        |
| Limitation of the possibilities to perform certain diagnostic and therapeutic procedures related to rare and pathological cases | 3.00; 2.00–4.00 | 1.00–4.00 | 1.841    | 0.066   |          |
| Difficulty in caring for patient's privacy and intimacy when performing a medical examination | 3.00; 2.00–4.00 | 1.00–4.00 | 4.925    | p < 0.001 |        |
| The influence of the ability to sense patient's real body and their reactions to touch on the reliability of the case | 3.00; 2.00–4.00 | 1.00–4.00 | 2.780    | 0.005   |          |
| The influence of the ability to observe patient's subjective reactions during medical examination on the reliability of the case | 3.00; 2.00–4.00 | 1.00–4.00 | 2.861    | 0.004   |          |
| The realism of the                                                | 2.00; 1.00–2.00 | 4.00; 3.00–4.00 | 11.936   | p < 0.001 |        |
Table 4 indicates that from the students’ point of view, simulation-based classes are more realistic when conducted with the use of an SP than with a manikin due, possibly, to the subjective reactions of a simulated patient. No statistically significant differences occurred between students’ answers to questions 14 and 40, 22 and 48, 29 and 55, 30 and 56, which can be interpreted, that students’ sense of realism of the learning process was not affected by the level of responsiveness, with the possibility to present rare and pathological symptoms or physical limitations of a manikin or an SP. Students provided statistically significant different opinions referring to the limitations of learning medical procedures with a manikin and an SP as well as the fact of working with a real person for understanding patients’ rights and feelings (answers to questions: 11 and 37, 12 and 38, 21 and 47, 23 and 49, 25 and 51, 26 and 52, 28 and 54).

Answers to additional pairs of questions that were not included above also provided statistically significant differences. The students’ awareness of working with a real person (a simulated patient) rather than a manikin may decrease their ability to concentrate and be precise when performing medical procedures (Z = 2.651; p = 0.008). Moreover, statistically more students compared learning with an SP to learning with a real patient (me = 4 vs. me = 2; Z = 11.975; p < 0.001) and more
students were more cautious when performing a physical examination on an SP rather than on a manikin \( (x^2 = 215.21; P < 0.001) \).

Analysis of students’ opinion about types of teaching modalities that can provide the most effective way of learning particular clinical objectives (questions 57–63)

The students were asked to mark which teaching modality provides the most effective way of learning particular clinical objectives. They were to mark one answer out of the following: ‘with an SP’, ‘with a manikin’, ‘with both manikin and SP’, and ‘none’.

[Table 5 near here]

| Which type of medical simulation is more effective in: | SP \( n; \% \) | Manikin \( n; \% \) | SP and manikin \( n; \% \) | None \( n; \% \) | Total \( n;\% \) |
|------------------------------------------------------|----------------|--------------------|--------------------------|----------------|----------------|
| Doing non-invasive simulation scenarios               | 133; 49%       | 18; 6%             | 117; 43%                 | 5; 2%          | 273; 100%      |
| Doing invasive simulation scenarios                   | 9; 3%          | 155; 57%           | 103; 38%                 | 6; 2%          | 273; 100%      |
| Learning technical Skills                             | 14; 5%         | 152; 56%           | 102; 37%                 | 5; 2%          | 273; 100%      |
| Learning medical procedures                           | 14; 5%         | 142; 52%           | 113; 42%                 | 4; 1%          | 273; 100%      |
| Learning complex medical procedures                   | 7; 3%          | 170; 62%           | 93; 34%                  | 3; 1%          | 273; 100%      |
| Developing communication skills                        | 208; 76%       | 9; 3%              | 51; 19%                  | 5; 2%          | 273; 100%      |
| Developing appropriate doctor - patient rapport        | 198; 73%       | 9; 3%              | 58; 21%                  | 8; 3%          | 273; 100%      |

Data do not add up to 100%, because students could indicate more than one answer

Figure no. 2 Courses using manikin-based simulation scenarios

According to the students, SP-based simulation scenarios were the most effective simulation-based way for learning non-invasive medical procedures. For learning invasive procedures, the majority of students preferred using a manikin. The most effective way of learning technical/manual skills, for example EKG, or endotracheal tube insertion, was provided during classes with a manikin (56%) or a combination of both modalities. In terms of learning basic medical procedures, like, for instance,
preparing the patient for a surgery, or taking biopsy, classes with a manikin (52%) or a combination of both modalities (42%) were considered most effective. 62% of students stated, that learning complex tertiary medical procedures was most effective with a manikin but 34% of them would combine using both modalities. Learning communications skills, including development of an appropriate doctor-patient rapport, was best facilitated with employment of an SP (76%; 73%).

In summary, the students preferred manikin-based classes when learning technical skills, including invasive and non-invasive procedures, however, some of them would choose a combination of using both manikins and SPs. In terms of developing communication and interpersonal skills, students were consentaneous about the high effectiveness of SP-based classes for learning this objective.

Performing particular medical procedures with a manikin and an SP (questions 64 and 65)

Students were asked to mark which medical procedures are better learnt with a manikin or an SP. In order to allow reliable analysis, examples of the same medical procedures available to be performed with both a manikin and an SP were provided as a list under each question. Students were allowed to mark more than one answer.

[Figure 5 near here]

Figure 5 presents that students favoured the assistance of an SP when learning most of the above-mentioned medical procedures. Learning about patient monitoring was one exception, as 108 students (68%) stated that it is easier when training with a manikin. The procedures considered to be learnt most effectively when practiced during SP-based simulation scenarios included taking patient history (86%, 235 answers) and communication with patients and their families. The most comparable result of this juxtaposition could be observed with reference to developing communication in a team, which, in students’ opinion, can be practiced with a manikin (45%; 122 answers) and an SP (53%, 145 answers) with almost the same level of effectiveness. This may be due to the fact, that learning communication in a team shifts the object of the learning objective from a patient to team members.

57 questions investigating students’ opinion about manikin-based and SP-based classes, which used the 4-point Likert scale, were taken into consideration to evaluate the internal consistency of the questionnaire. The statistical testing yielded Cronbach’s alpha of 0.811 for that instrument, which
confirms high reliability of the applied scale.

Discussion

The results show that the students have a wide range of clinical skills teaching with manikins (both low and high fidelity) and SPs, which occur once or twice a week. This regular and routine experience allows a high level of confidence in the authenticity and credibility of the students' opinion. Students appreciate the opportunity to use manikins and simulated patients when learning clinical and practical procedures, and these have preference over instruction without them.

Learning with a simulated patient makes the experience realistic, allowing a more natural interaction between two people with the possibility of observing some of the physical findings in a real person, which suggests that the type of simulated patient should match the type of clinical objective to be learnt in a particular simulation scenario. This is in agreement with the findings of Coffey et al. [2], and Wisborg et al. [3].

Manikins have advantages over SPs in situations where learning a skill may require performing and repeating similar or complex medical procedures and algorithms. The manikin allowed students unlimited possibilities to develop skills and habits, and to develop confidence. Papers by Bragard et al. [12]; Ker and Bradley [9]; Bokken et al. [18]; Cleland et al. [7], Cooper and Taqueti [13]; Ahmed et al. [14] all support this. Moreover, combining a manikin with an SP in simulation-based classes made learning non-technical skills and some of the non-invasive procedures more effective, especially in terms of developing skills related to doctor-patient communication and rapport [9, 26].

Additional benefits noted by students, but not found in the literature included the experience of teamwork and application of communications skills. Dealing with occupational hazards, and in particular patients with an infectious disease, in a safe environment was recognised as being important.

Conclusions

The results are significant because the decision to use of SPs and manikins was based purely on the Faculty’s opinion without any consultation with students. This investigation indicates the Faculty’s judgement and provides evidence of the strength of students’ opinion.
The results suggest that both manikins and SPs should be included in the medical curriculum from the beginning of students’ clinical experience. A combination of both modalities will ensure that students learn technical and non-technical skills from experienced health-care professionals. Simulated patients should be included in the final years of medical curriculum for evaluating and assessing communication skills.

One of the main concerns in simulation is to provide a level of realism that is appropriate for the student’s level of development. The results suggest that the student experience of simulation does encouraged positive attitudes towards learning clinical medicine. The level of realism should be gradually increased from the first years and end up with high fidelity scenarios with manikins in Year Six. A more detailed evaluation, including a cost-benefit analysis would be required to provide a more detailed conclusion. However, this study is the first step for Polish medical schools to provide an analysis of the use of educational models, SPs and manikins, together with the level of realism in high-fidelity scenarios used in medical simulation. The results so far seem to support the principle.

Further study
A number of issues were revealed in the results that require further investigation. These are related to cost effectiveness and optimum time allowed for each modality, taking into account the different clinical fields, e.g. internal medicine, surgery, Ob/Gyn, and also taking into consideration inter-professional education. Issues about the benefits of using manikins and SPs in assessments with respect to standardisation, competence and capability should be considered.

Study limitations
There was no control group from a traditional school with which to establish an opinion from students who had not used SPs. It was also difficult to determine if students’ access to the manikins and SPs was limited to formal teaching times, or if students had access to them in their own time. The study was completed in a single school, and replication in other schools would be desirable to validate the results.

Declarations

ETHICS APPROVAL AND CONSENT TO PARTICIPATE

This study was approved by the Medical University in Lublin. All participants provided written,
informed consent.

**CONSENT FOR PUBLICATION**

Not applicable.

**AVAILABILITY OF DATA AND MATERIALS**

Data access will be considered upon request from Ms Natalia Radczuk: natalia.radczuk@umlub.pl

**COMPETING INTERESTS**

The authors declare that they have no competing interests.

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**AUTHORS’ CONTRIBUTIONS**

KT have made substantial contributions to the conception and designing the work; PE contributed to the study design and analysis of the data; NR contributed to the interpretation of data, language revision and preparation the manuscript; AT substantively revised the work

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Not Applicable

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Figures

TORRES K et al.: What is the students’ opinion about using scenarios with manikins and Simulated Patients in undergraduate medical education?

FIGURES

Figure 1. Courses using SP-based simulation scenarios

Basic Clinical Skills 45%
Courses using SP-based simulation scenarios

Data do not add up to 100%, because students could indicate more than one answer

Figure 1

TORRES K et al.: What is the students’ opinion about using scenarios with manikins and Simulated Patients in undergraduate medical education?

Figure no. 2 Courses using manikin-based simulation scenarios
Courses using manikin-based simulation scenarios

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Figure no. 3 Learning clinical objectives
Figure 3
Learning clinical objectives

TORRES K et al.: What is the students’ opinion about using scenarios with manikins and Simulated Patients in undergraduate medical education?

Figure no. 4 Features/limitations of a method vs. realism
Figure 4

Features/limitations of a method vs. realism

TORRES K et al.: What is the students’ opinion about using scenarios with manikins and Simulated Patients in undergraduate medical education?
Figure 5 Learning particular medical procedures with a manikin and an SP (N=273 for both variables)

Data do not add up to 100%, because students could indicate more than one answer

Figure 5

Learning particular medical procedures with a manikin and an SP (N=273 for both variables)

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