

**A comparison of manikin based simulators and patient monitor simulators within paramedic education: The student perspective.**

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## ABSTRACT

**Objective** - Investigate the impact to paramedic students of patient monitor simulators, when compared to manikin based simulators within an educational programme.

**Design** - An exploratory study using an online questionnaire to gain qualitative and quantitative data.

**Setting** – One London university delivering a paramedic science programme.

**Participants** – A total of one hundred and thirty-six Paramedic students sponsored by a UK ambulance service were approached for this study. Data were received from forty-three respondents (32%).

**Main outcome measures** - Comparison of simulators and their effect upon student development through the identification of the student's own perceived ability following use; perception of other's ability (fellow students studying same course) following use and perception of the two pieces of simulation equipment available.

**Results** - The majority of respondents identified that simulation both increased their confidence and ability to demonstrate new knowledge and skills during simulation (97%) and further increased their ability to manage real patients (95%). Respondents agreed that there were advantages and disadvantages of using simulation, but these were not in line with those identified in previous studies. Instead of the human factors and non-technical skills outlined, students were much more practically focused on how the equipment performed.

**Conclusions** - This study suggests that there is a clear link between simulation and increased student confidence, but any issues encountered with the simulator equipment can reduce this benefit causing the student's learning environment to falter. Transitioning to monitor based simulators is seen as a positive move, although the integration of manikins with this equipment is identified as being necessary.

What is already known on this subject:

Previous studies have identified the perceived importance of simulation in educating healthcare workers. However, they have predominantly focused upon the level of fidelity and its validity when compared to actual experience, opposed to how the equipment is perceived by students. This has led to a lack of studies looking at the overall impact of simulators on student development.

What this study adds:

This study suggests that the advantages of simulation perceived by students are different from those generally identified by academic institutions and manufacturers. Equally improvements made to simulators so that their level of fidelity is increased can sometimes create a barrier to the students overall learning, something that needs to be realised and understood so as to minimise any adverse impact.

## **INTRODUCTION**

The benefits of simulation within healthcare have been established over a number of years resulting in a proactive move to develop its presence within a number of training and educational programs.<sup>1</sup> The focus of this development has for the most part been on the introduction of large scale facilities and events where the student is immersed within an environment allowing for targeted learning.

Whilst these centres and events gain the most recognition, the component parts that go into establishing these simulated environments are often overshadowed, in particular any equipment students use to develop their practical skills. This is especially true when the relatively rapid evolution of technology is aligned with the perceived requirements of said students.<sup>2,3</sup>

It is common place for technology to dictate how students learn and this is seen clearly with regard to manikin based simulators which increase their key operating features and subsequent usability on a frequent basis.<sup>4</sup> However, as they have advanced, their use is sometimes seen as troublesome, impractical and no longer fit for purpose.<sup>5</sup> This has resulted in new devices being produced that mimic the assessment/monitoring equipment carried by healthcare workers so that the manikin itself does not necessarily have to be as advanced as it once was.<sup>6</sup>

Although there are several studies concerning simulation, the majority have focused upon fidelity and the validity of simulation versus experience. Thus resulting in a lack of published work looking at how students perceive the use of such equipment.

This study aimed to investigate the impact to paramedic students of patient monitor simulators (Figure 1), when compared to manikin based simulators (Figure 1) within an educational programme and whilst it may be hypothesised that students would prefer the new simulators due to their ease of use, this study explores whether the equipment is actually perceived by students as being effective and advantageous in their studies and on-going practice.

## **METHODOLOGY**

This was an exploratory study using a mixed methods approach which took place over nine months (January – September) during 2016. A questionnaire using different question styles produced both quantitative and qualitative data, which could be analysed through the use of varying measurement techniques. This allowed comparisons to be made between the data derived from both methods<sup>7</sup> and facilitated a greater level of integration.

### **Student Demographic**

Whilst initial consideration was given to targeting staff across numerous ambulance trusts and universities the inherent issues around resourcing, timeframe, confidentiality and ethics made this untenable. Therefore, in order to achieve a suitable study that could potentially be

expanded or replicated in the future a single University running a Paramedic Science programme was used.

Therefore, Students sponsored by South East Coast Ambulance Service NHS Foundation Trust to undertake the Paramedic Science Programme at St George's, University of London were chosen as the participant pool. This guaranteed that all students had experience of the equipment being studied from both the university programme and the respective trust, thus allowing everyone to provide informed responses and offer an appropriate level of comparison where needed.

The research group was composed of 7 paramedic cohorts covering three years, resulting in a pool of n=141 participants. This was comprised of 106 students currently undertaking the Paramedic Science programme and 35 students that had already qualified from the same programme (within 2 months of exam board). The expected return percentage (30% - 70%) offered a favourable level of representation over the varying years and thereby allowed for a good level of comparison to be made.<sup>8</sup>

## **Preparation**

### Questionnaire

A formulated questionnaire was used due to its shorter collection and collation timeframe, whilst maintaining a good level of precision throughout.<sup>8</sup> Its structure and content was designed following a literature review, identifying questions that focused on the students' experiences around the topic being researched. Questions were structured using both the Likert scale and closed/open-ended questions.

This structure maintained the focus on three key themes; Student's own perceived ability; Perception of other's ability (fellow students studying same course) and Perception of simulation equipment, thereby facilitating data that looks at the attainment of competency and confidence when discussing specific equipment.

Although confidence is an intrinsic part of developing an ability, the subjective nature of assessing it often calls into question its validity. Therefore, questions were developed using the 'Academic Confidence Scale',<sup>9</sup> which allows students to identify their perceived level of confidence regarding a given subject and place some measured attribution to it. Due to the initial Academic Confidence Scale questionnaire focusing on the general area of academia, its focus was not deemed as being fully appropriate for this study. Therefore, the scale was used as a foundation allowing question development to be structured around the core premise so as to gain a suitable level of perception.

Whilst this scale looks at the individual it was important to gain a clearer view as to how they saw themselves in regards to their peers. Therefore, additional questions were developed through the use of the 'third-person effect',<sup>10</sup> which uses parallel questions to offer participants a greater ability to compare themselves to others relative to any specific task.

By using both the principle components of a validated tool and the process of the third-person effect students had the opportunity to identify their perceived confidence relevant to the theme of study, whilst allowing the data to be based upon tried and tested collection techniques. This further increased their ability to identify the level of 'non-cognitive academic achievement' reached.<sup>11</sup>

To ascertain the effectiveness of the questionnaire and identify whether it was replicable throughout the study it was trialled online by a prior student of the same programme and a manager responsible for students currently studying the programme. This established there were no problems regarding interpretation, completion and submission of the questionnaire, and that the information collected could be collated appropriately.

## **Process**

An information email was sent to all potential participants which not only introduced the study and the researcher, but also contained an embedded link to the online questionnaire. This email was distributed through a generic university account and not by the researcher, therefore allowing all participants to make an informed decision as to whether they wished to voluntarily participate in the study whilst remaining anonymous. This allowed those who engaged with the study to imply consent merely by completing the questionnaire and negating the need for any additional documents to be used.

The questionnaire remained accessible for three weeks from the original email and in that time four reminder emails were sent. This equated to one after each of the first two weeks, followed by a further two reminders within the final week. The intention being to maximise student engagement.

Once all of the questionnaire data had been collected it was collated in order to provide a suitable mix of numerical and themed information which could be presented and analysed appropriately. This was automatically undertaken through the use of the online survey tool and facilitated a nominal and ordinal measurement which provided a clear baseline allowing comparisons to take place around the themes found,<sup>7</sup> namely the validity of simulation and relevance of any equipment used.

To support this, the qualitative components derived from the questionnaire were analysed manually by the author and themes and key words (quasi-statistical) were identified and coded accordingly. This approach allowed for a direct comparison to be made between both the quantitative and qualitative data streams, thereby facilitating a clear route of analysis.<sup>7</sup>

## **Ethical Approval**

Approval to undertake this study was sought from the Kingston University and St George's, University of London Faculty Research Ethics Committee on 17<sup>th</sup> May 2016 with a favourable outcome being given on the 6<sup>th</sup> June 2016, (Ref: FREC2016/05/008).

## **RESULTS**

From the potential pool of 141, 136 students were identified as being eligible to receive the questionnaire invitation. This was due to 5 students having left the programme for differing reasons during the six months between study design and commencement. Following the closing date 43 completed questionnaires had been returned equating to 32% of the invites issued.

## Perceived Ability

Following review, the data showed the majority of respondents identifying that the use of simulators within their course had increased their patient management ability (Table. 1) and therefore formed an essential component for the transition of theory to practice.

Perceived confidence in demonstrating knowledge and skills using the simulators and having this translate into real world applications was also identified to a high degree (Table. 1). This view was something that was further expressed through the statement that simulation can reduce the fear factor of managing real patients.

Response Measure	Increase in patient management ability due to using simulators.	Transfer from simulated patients to real patients, own ability-versus fellow Students.		Confidence between simulated environment and operational environment	
	Increased Ability n=43	Own Ability n=43	Fellow Students n=43	Simulated Patients n=43	Real Patients n=43
<b>Strongly Agree</b>	<b>62.8%</b>	<b>58.1%</b>	<b>18.6%</b>	<b>62.8%</b>	<b>62.8%</b>
<b>Agree</b>	<b>32.6%</b>	<b>37.2%</b>	<b>69.8%</b>	<b>34.9%</b>	<b>34.9%</b>
<b>Uncertain</b>	<b>4.7%</b>	<b>4.7%</b>	<b>11.6%</b>	<b>2.3%</b>	<b>2.3%</b>
<b>Disagree</b>	<b>0.0%</b>	<b>0.0%</b>	<b>0.0%</b>	<b>0.0%</b>	<b>0.0%</b>
<b>Strongly Disagree</b>	<b>0.0%</b>	<b>0.0%</b>	<b>0.0%</b>	<b>0.0%</b>	<b>0.0%</b>

*Fellow Students are those studying the same Paramedic course.*

**Table 1. Self-Perceived Ability Scores**

## Advantages

The manikin based simulators were recognised for their level of realism, mainly due to being of humanoid design and able to replicate core observations e.g. pulses, respiratory sounds. They were also seen to be preferable in facilitating a range of differing scenarios due to their level of versatility and potential fidelity (29.84%).

The patient monitor simulators were also seen as being versatile in regards to different scenarios (28.91%), but also their functionality with manikins and standardised patients was identified. Furthermore, with their base construction being that of an iPad, students (22.66%) found the level of familiarity with this equipment beneficial and felt comfortable using it.

## Disadvantages

Figure 2 identifies how students had been disadvantaged when using both simulators as part of taught sessions or assessments. For manikin based simulators the ability to move or position the manikins was seen as the biggest issue, alongside the fact that they were often broken in some way or another. It was further identified that the leads used to read cardiac rhythms often became disconnected during scenarios resulting in any increased fidelity being lost.

The patient monitor simulators were seen by students as often experiencing technical issues, e.g. screen freeze, dropped their programme or the battery failed. This was as well as the process for setting up and running a programme being viewed as too complicated.

## Learning Approach

The larger percentage of students expressed the view that different simulators often required them to alter the way in which they approached the learning event (Table 2), this was equally dependent upon the subject matter and any issue encountered during the simulation itself. This view is not shared by all with a significant group remaining uncertain as to whether this is the case and a smaller group disagreeing that this has happened. These views are linked to the reasons identified within Figures 2 and 3.

**Table 2. Altered Approach to Learning**

<b>Have students had to change their approach to learning dependent upon the simulator being used?</b>	
<b>Response Measure</b>	<b>Altered Approach n=43</b>
Strongly Agree	<b>14.0%</b>
Agree	<b>53.5%</b>
Uncertain	<b>20.9%</b>
Disagree	<b>11.6%</b>
Strongly Disagree	<b>0.0%</b>

## Preference

When asked to choose their preferred simulator for undertaking scenarios, students predominantly expressed a preference for the patient monitor simulator (Table 3). To support their respective choice students provided reasons as to why one simulator was preferred over the other (Figure 3). Whilst 5 categories could be derived from the responses, several comments would not clearly fit within these and so were categorised as 'other', (e.g. superior and modern; just being one device; depends on the scenario).

**Table 3. Preferred Simulator**

Which simulator is preferred when undertaking scenarios?	
Patient Monitor	Manikin Based
79.1%	20.9%

## DISCUSSION

The study was designed to look at how students perceive their overall ability to manage patients during the programme when using specific simulators and how that could transition to the operational environment. Given the positives identified in previous papers it was expected that students would benefit from the use of simulation as part of a structured programme and that this would result in an increase of their clinical ability.<sup>12</sup> The results (Table. 1) clearly support this expectation and show that there is a greater self-perceived ability drawn from utilising simulators as part of the programme, something which is further supported by a rise in perceived self-confidence and whilst a self-perceived notion does not necessarily translate into actualisation the results do demonstrate the ability for an increased level of belief albeit non-cognitive from which to develop.<sup>10</sup>

In demonstrating this duality between simulation and real world application the study has touched on the areas of confidence and competence, which are argued by some as having little correlation due to students having misplaced views as to their own ability, which in turn causes a barrier to their ongoing development.<sup>13</sup> Whilst this study is unable to provide a basis for this view, what can be seen are students willing to maximise their learning experience through the use of simulators in a variety of guises.

### Simulator advantages and disadvantages

Whilst simulation as a whole is seen as being beneficial due to the varying practicalities associated with the simulation equipment utilised.<sup>14,15,12</sup> This study did not fully agree with the generally accepted advantages put forward regarding simulation.<sup>15</sup> Instead of benefits such as; modification of learning, safe replication, objective assessment and immediate feedback,<sup>14,15,12</sup> we see the manikin based simulator identifying realism, versatility, ease of use and familiarity as its top four themes and the patient monitor simulator identifying versatility, familiarity, modern technology and ease of movement as its top four.



The data showed minimal correlation with current publications around advantages and disadvantages resulting in disparity between what is currently thought and what has been found.<sup>7,13,14</sup> Just two areas aligned, firstly 'Immediate/Instant feedback' was stated with regard to the patient monitor simulator and secondly 'Safe Repetition' (stated within versatile) in reference to the manikin based simulator. These comments were made by just a few individuals and potentially demonstrate the dichotomy experienced by general academics and equipment manufacturers when developing simulation technology for student use.

It was hypothesised that students would predominantly favour what they already knew due to familiarity or ultimate trust, but the data suggests otherwise.<sup>6</sup> As with anything relevant to healthcare, educational programmes continue to evolve as do the requirements of simulators and having a piece of equipment that does not meet student expectation is often detrimental leading to times when the student feels as if they are losing control of their learning environment, resulting in a loss of perceived fidelity and overall confidence.<sup>6,16,17</sup>

Although the study group did not for the most part feel disadvantaged through their use of the simulators the distinction is not absolute and whilst this is often perceived as being down to having the wrong equipment,<sup>17</sup> the data points towards students seeing technical issues relating to reliability as being the clear barrier to their learning. Something which could equally impact how the students have compared the two simulators within this study.

Several studies have been undertaken and discussed where different manikins have been used with varying student cohorts,<sup>6</sup> but these have mainly focused on how different developments have improved them and not on whether students have had to alter their approach to learning due to issues encountered. This study has identified that a greater number of students (Table 2) do see themselves as having to change their way of studying dependent upon the simulator they are using and whilst this is not clear cut due to the specifications of the different simulators, it does highlight areas raised in previous studies as to the individuality of students and how they engage with simulation.<sup>18,19,20</sup>

## **Predilection**

The primary aim of the study was to compare two simulators and ascertain which is preferred by paramedic students. Of the two simulators compared the patient monitor simulator was preferred by nearly four times as many students as that of the manikin based simulator (Table 3). Those who preferred the manikin did so for reasons such as (Figure 3) the ability to use their own equipment with it and the fact that it was familiar to them and a good representation of a human with which they can work. Whereas the patient monitor simulator was seen as having a greater level of versatility meaning it can be used with manikins and standardised patients; better reliability, ease of use (as hypothesised) and familiarity due to looking like current cardiac monitors.

Whilst the manikin based simulator is seen as less desirable its practical use alongside the patient monitor simulator does offer an acceptable level of fidelity for some scenarios. The need to alter their approach dependent upon the simulator being used was indicated, although a level of acceptance around any issues (Figure 2) was demonstrated allowing the

students to add layers of complexity as they go, thereby developing their overall management and problem solving techniques that are an intrinsic part of pre-hospital care.<sup>21</sup>

## **Applicability**

This study was initiated to respond to changes within the arena of simulation, both as a general entity and more precisely in regards to the introduction of new equipment as part of a university programme. From the data collected the perceived benefits of the simulators as outlined by prior papers do not seem to be fully recognised.<sup>14,15,12</sup> In addition, students are identifying further unexpected issues when using the simulators, which as well as potentially compromising their learning, could also affect the comparisons made within the study. However, it is this information that can be utilised to make changes to how both simulators are used from the lecturer and students' perspective, thereby allowing a greater level of alignment to both student need and lecturer expectation.<sup>12,14,15,22</sup>

It would be deemed appropriate to review the technological issues around the patient monitor simulator and make sure that it is both, user friendly and reliable. Equally due to the excessive movement of the manikin based simulators causing them to become damaged and therefore not always be in a fully working state, they need to either be pre-positioned ahead of time ready for students, or maybe replaced with less complicated manikins that are more durable, but could still work alongside the patient monitor simulators. By managing the equipment in this way, incidences where students struggle to engage with the scenarios due to a loss of equipment fidelity would be minimised allowing for a greater and more effective learning environment.<sup>6,16,17</sup>

## **Study Limitations**

Firstly, a reduced participant group resulted in limited data being collected. Although the return rate of questionnaires was within the expected range, an increase in this number through the use of alternative data collection techniques would have provided a greater level of representation.

Secondly, the reliability and quality of the simulators was often called into question whereby students commented upon them being broken or failing due to mechanical or technical reasons. Although this provided discernible reasons as to why a simulator may not be liked, the level of comparison made may not have always been on an equal footing opposed to if all equipment was complete and in fully working order.

Finally, because the Academic Confidence Scale was used as a foundation from which to develop the questions, the resulting data may not be as robust as it could have been if the scale was used in its entirety.

However, despite these limitations the aim of the study was achieved and sufficient data were collected and analysed in order to provide a suitable level of clarity around the subject and advise as to how the change between simulators could be maximised for overall student benefit.

## **CONCLUSION**

This study has demonstrated a clear link between the use of simulation and the increased level of confidence perceived by students.<sup>18</sup> It has further identified that although readily accepted as being of benefit, simulators often cause students unnecessary issues arising from their use.<sup>2</sup> This can often result in a negative impact to the student's overall learning experience and disrupt their development.

There was positive feedback regarding the transition from manikin based simulators over to monitor based simulators, but the study also identified the need to have both simulators to be interchangeable and work together. It was further highlighted that they must always be in a fully working state, otherwise they will never become entirely integrated as part of the curriculum and whilst students can modify their learning approach and adapt to this, it is still essentially a barrier to their overall learning.

Additional studies could look at different healthcare professions using the same simulators as part of student development to ascertain if the views expressed within this paper are comparative.

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### **Competing Interests**

I have read and understood BMJ policy on declaration of interests and declare the following interests: I am employed by both the University where this study was undertaken and by the ambulance trust responsible for sponsoring the students. However, it is not felt that these associations impacted my judgement when undertaking this study.

### **Contributors**

Pete Woodford critically reviewed the initial study proposal and final report. Dr Dimitra Nikolettou proofread and advised about technical editing of the manuscript.

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