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1 Can a High Fidelity Simulation Tutorial Improve Student's Written Examination Results? A  
2 Review of a Change in Teaching Practice

3  
4 Key Points:

- 5 • Undergraduate nursing population is changing and they prefer technology  
6 enhanced learning (Jones et al. 2015).
- 7 • Students evaluated High fidelity simulation tutorials well. Examination results  
8 compared to the previous cohorts did not show an improvement however there  
9 were a variety of factors preventing a direct comparison of the results.
- 10 • Literature indicates that the debriefing after the High fidelity simulation is the  
11 most valuable learning experience and sufficient time should be allocated for this.
- 12 • Students struggle with an unstructured discussion and a structured debriefing  
13 tool should be used.
- 14 • Technology errors can deduct from fidelity of the simulation and cause  
15 disengagement with students (Cant and Cooper 2017).
- 16 • The INACSL Standards Committee et al. (2021) and the ASPiH (2016) have  
17 produced standards for simulation design which should be implemented to ensure  
18 an effective simulation design and assessment.

19 Keywords:

20 High fidelity simulation, tutorial, debriefing, fidelity, summative assessment, student  
21 examination

22 Reflective Questions:

- 23 • What other innovative teaching methods could have been used to prepare the  
24 students for their summative assessment?
- 25 • From your own experience how have you found debriefing discussions post  
26 simulation activities that you have been involved in?

- 27           • What other reasons could there be for the student's lack of participation in the  
28           post simulation discussion? What are the possible solutions to address this?

29   Abstract

30   *Background:* Undergraduate nursing students prefer technology based learning. Simulation  
31   has been used within nursing education to provide skills acquisition and clinical exposure.  
32   Can high fidelity simulation (HFS) be used to teach tutorial content to prepare students for a  
33   written examination?

34   *Aims:* To design a pilot HFS tutorial

35   *Methods:* 203 2<sup>nd</sup> year undergraduate student nurses were timetabled to attend a HFS  
36   tutorial. Examination results at 1<sup>st</sup> attempt were compared to the previous cohort's results.

37   *Findings:* 81% of the students from the HFS tutorial cohort passed at first attempt compared  
38   to 85% from the previous cohort.

39   *Conclusion:* HFS tutorial needs to be developed further incorporating simulation standards to  
40   further assess its ability to improve student's written examination results. Students found the  
41   post simulation discussion difficult and wanted guidance for it. Involvement of the  
42   University's skills and simulation team would be recommended for future cohorts to assist  
43   with design and facilitation.

44

45

46   Manuscript

47   Introduction

48   The current undergraduate student nurse population are from Generation Y and Generation  
49   Z, which Jones et al. (2015) identifies as a student population that prefers technology

50 enhanced learning. Within the United Kingdom since the introduction of tuition fees for pre-  
51 registration nursing programmes in 2017 and removal of the Government funded student  
52 nurse bursaries, there has been a reduction in the number of mature students applying for  
53 pre-registration nursing courses (RCN 2019). Generation Z prefer technology based learning  
54 as it provides them with greater ownership and flexibility in their learning (Romli et al. 2020).  
55 As technology advances technically savvy students will expect their education to incorporate  
56 more non-traditional elements of education delivery (Romli et al. 2020).

57 The aim of this paper is to review a change in how undergraduate nursing students were  
58 taught their tutorial content in preparation for their written examination. The module was  
59 designed to teach the students how to assess and safely care for adult patients with a variety  
60 of acute illnesses using the ABCDE (A-E) assessment approach (RCUK 2021). The  
61 summative assessment was a written examination based upon patient scenarios that the  
62 students were given previously. Within the examination the students had to answer three  
63 questions: describe the assessment that they would undertake for the patient in relation to  
64 their observations, explain pathophysiology of patient's clinical condition and provide rationale  
65 to a particular aspect of nursing care related to the patient scenario. Historically the students  
66 evaluated the module well but had poor examination results at first submission. High fidelity  
67 simulation (HFS) has been previously used on the nursing course to provide exposure to  
68 clinical situations and was well evaluated by the students. This paper will discuss a change to  
69 teaching methods to incorporate the use of HFS for the students' tutorials to improve their  
70 examination results.

## 71 Literature Review

72 Simulation is an active learning approach which enables nurse educators to provide students  
73 with exposure to complex clinical situations within a safe environment to develop and practice  
74 their clinical, critical thinking and reasoning skills (Newton and Krebs 2020). Simulation in  
75 conjunction with other teaching methods has been found to increase the knowledge gain of  
76 undergraduate nursing students who identify a preference for different learning styles

77 (Shinnick and Woo 2015). Using simulation is beneficial for the development of clinical skills,  
78 problem solving and team working within healthcare (Sadka 2021).

79 Simulation can be divided into two categories: low fidelity and high fidelity; the greater the  
80 fidelity the more believable the situation is (Cant and Cooper 2017). The fidelity requirement  
81 of the simulation session only needs to be as high as necessary to achieve the teacher's  
82 learning outcomes (Kirkham 2018). Low fidelity simulation (LFS) can assist with students  
83 learning clinical skills such as blood pressure measurement (Cant and Cooper 2017). HFS  
84 may involve the use of an actor or a computerised mannequin to demonstrate realistic clinical  
85 scenarios and patient physiological parameters. The mannequin can also be used to  
86 demonstrate a patient's deterioration, and may also be able to interact with the learners to assist  
87 them with their communication skills (Au et al. 2016).

88 There has been an increase in the use of HFS in nursing education since the 1990s (Au et al.  
89 2016). Simulation has been found to increase nursing student's knowledge and self-  
90 confidence, critical thinking and assessment skills (Lee et al. 2019). It has also been used as  
91 a teaching method for bridging the gap between taught theoretical content and practice within  
92 a healthcare setting (Newton and Krebs 2020). However, it can also induce high levels of  
93 anxiety which can diminish a student's performance and deduct from their overall learning (Al-  
94 Ghareeb et al. 2019). The ASPiH (2016) recommend that psychological safety of the learner  
95 should be considered by the simulation facilitators as the learners can experience heightened  
96 levels of anxiety especially if simulation is used as an assessment method. However the  
97 relationship between anxiety and HFS was not recorded by Burbach et al. (2019), a study of  
98 120 participants that took place within the USA. Anxiety can be difficult for people to admit to  
99 and assess which could explain the different findings.

100 Nursing students are required to have 2300 hours of clinical practice exposure, of which 300  
101 hours can be spent within simulation (NMC 2021). Simulation has gained popularity within  
102 nursing education as a way to provide clinical exposure when clinical placement places within  
103 healthcare are limited (Roberts et al. 2019).

104 HFS is frequently used within medical education as it enables the learner to see physiological  
105 feedback in relation to their medical decisions without patient risk (Alluri et al. 2016). However  
106 there is research which suggests that the learning achieved by HFS does not bear a  
107 statistically significant difference to that by LFS (Massoth et al. 2019). In fact HFS can have a  
108 worse performance in knowledge gained than LFS and can cause medical students to feel  
109 overconfident in their skills and performance (Massoth et al. 2019). Simulation continues to  
110 be used now to not only train medical and nursing students in clinical skills acquisition but also  
111 with interprofessional working relationships and team working, which are vital when caring for  
112 acutely ill patients (Stewart et al. 2010; Kirkham 2018).

113 Traditionally written assessments have been accepted as a method to assess student's ability  
114 to care for acutely ill patients (Storm et al. 2015). Simulation within healthcare professional  
115 training provides a safe environment to practice clinical skills without compromising patient  
116 safety (Ryall et al. 2016). Previous reviews of literature have found that written and simulation  
117 assessments differ in their ability to assess learner's knowledge and practical skill (Ryall et al.  
118 2016). Simulation can be used formatively to identify and close gaps in participants' knowledge  
119 and monitor progress towards achieving set learning outcomes (INACSL Standards  
120 Committee et al. 2021a). There was no literature found discussing the use of HFS as a  
121 teaching method in preparation for a written examination.

## 122 Method

123 The HFS tutorial was incorporated into the 2<sup>nd</sup> year undergraduate module. Within the last  
124 lecture before the HFS tutorials commenced the lecturing team brought a mannequin and  
125 equipment into the lecture theatre and demonstrated an A-E assessment (RCUK 2021) for the  
126 students, pausing after each step so that they had the opportunity to ask questions/ clarify  
127 what was happening. The patient scenario used involved a patient showing signs of sepsis.  
128 This was one of the students' module examination scenarios. The other HFS tutorial scenarios  
129 were drawn from the remaining module examination scenarios. These scenarios involved

130 patients experiencing post-surgery pain, a myocardial infarction and a small bowel obstruction.

131 These were chosen as they are conditions commonly encountered in clinical practice.

132 There were nine HFS tutorials and the students were allocated one session to attend to. Each

133 HFS tutorial had approximately 22 students. The learning outcomes for the HFS tutorial were:

- 134 • To work as a team to complete an A-E assessment on the patient (RCUK 2021)
- 135 • Document their assessment on appropriate paperwork
- 136 • At the end provide a handover of their assessment using the SBAR communication  
137 tool (Situation, Background, Assessment, Recommendation) (NHS 2010)

138 At the beginning of each HFS tutorial the students were split into three groups of approximately  
139 seven students each. Each group rotated around the three mannequin stations that were set  
140 up for them and facilitated by a lecturer, who was a registered general nurse. Within their  
141 group, two or three students would volunteer to work together to undertake an A-E assessment  
142 (RCUK 2021) upon a patient scenario whilst the remaining students within their group  
143 observed them. This task was chosen as within the students' summative examination their  
144 first question was to write about an A-E assessment (RCUK 2021) they would have completed  
145 on the patient scenario. This was also the first examination question asked to the previous  
146 cohort (2016/2017).

147 The mannequins were high fidelity in that their physiological parameters responded to the  
148 intervention that the students made. The voice of the mannequin was provided by the lecturer.

149 When the students were not involved with undertaking an A-E assessment (RCUK 2021) on  
150 the mannequin their role was to make observation notes to aid their participation in the post  
151 simulation discussion. Each mannequin scenario lasted for approximately 10-20 minutes and  
152 ended with students providing a verbal handover of their assessment to the observing students  
153 and facilitator. Some students did not complete the full assessment and therefore handed over  
154 what they had managed to complete. The simulation was followed by a 20 minute unstructured  
155 discussion facilitated by the lecturer. During this discussion the students were asked how they

156 felt the scenario went, what was the rationale behind some of their decisions, and could ask  
157 any questions they might have related to the scenario.

158 The format and timings of the session and discussion were designed to be familiar to lecturers  
159 and students, as it resembled the skills and simulation teaching previously taught within the  
160 pre-registration nursing course. At the end of the HFS tutorial the students were given an  
161 evaluation form to complete (Appendix A). This was all conducted in line with the University's  
162 clinical skills and simulation teaching strategy.

### 163 Results

164 Both cohorts were undergraduate adult student nurses in their 2<sup>nd</sup> year of a 3 year course.  
165 The majority of the module's theory content was taught in the first semester (September to  
166 December). For the 2017/2018 cohort the HFS tutorial was delivered at the beginning of the  
167 second semester (January-April). The 2016/2017 cohort had a lecture preparing them for the  
168 summative examination at the beginning of the second semester. Both cohorts had clinical  
169 placements throughout the academic year; at least one of these was in an acute setting. The  
170 summative examination for both cohorts was after the holiday break in April.

### 171 Table 1

172 Table 1 shows a summary of results, based on marks released to student's post-moderation:

Cohort	No students taking module	Passed at 1 <sup>st</sup> attempt	Minimum mark	Maximum mark	Average mark
2016/2017	223	189 (85%)	14%	96%	59.01%
2017/2018	203	165 (81%)	14%	90%	49.49%

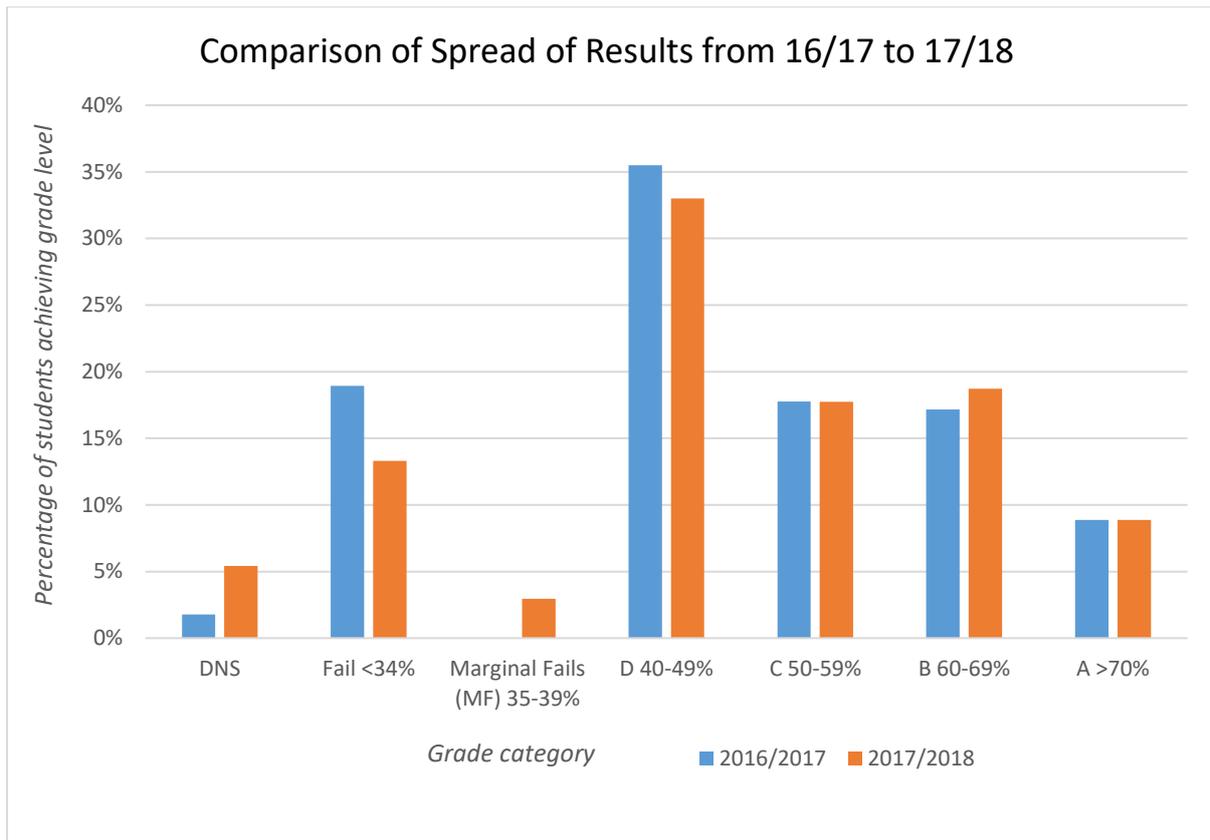
173

174

### 175 Figure 1

176 Figure 1 shows the spread of students marks across the grade boundaries.

177



178

179 **Discussion**

180 The HFS tutorial did not show an improvement in student’s examination results at first attempt  
 181 compared to the previous year. However, a direct comparison between the results of the 2  
 182 cohorts is difficult for numerous factors. The 2016/2017 results are missing data from 55  
 183 students. Between the two academic years the format of the summative examination changed  
 184 from two questions worth 50% each (2016/2017) to three questions worth 50%, 25% and 25%  
 185 (2017/2018). Describing the A-E assessment (RCUK 2021) for the patient scenario was still  
 186 the first question for both cohorts. Finally during the 2016/2017 assessment moderation  
 187 process the exam results were increased across the board as it was deemed that the students’  
 188 submissions had been under-marked across the exam markers. This did not happen with the  
 189 2017/2018 results.

190 On reviewing the student evaluation forms post the HFS tutorials (Appendix A) one of the  
 191 themes was that they found the HFS tutorial to be helpful, but not the unstructured discussion  
 192 afterwards due to lack of guidance. This was unexpected as the format of the HFS and the

193 discussion was similar to what they had completed previously within the course and there  
194 were no unsatisfactory reports from those occurrences.

195 The debrief discussion is the most important aspect of simulation based learning (ASPiH  
196 2016). The debrief discussion is where the learner gains new understanding and learning,  
197 linking theory to practice through reflecting on what they have participated in and observed  
198 (INACSL Standards Committee et al. 2021b). Although there is no specific guidance on the  
199 duration of the debriefing process there should be adequate time allocated for assisting the  
200 learner to achieve the learning outcomes, address any elements they which to discuss, and  
201 identify gaps in knowledge (INACSL Standards Committee et al. 2021b). Due to timing  
202 constraints in the HFS tutorial the post simulation discussion was only allocated approximately  
203 20 minutes. This was not sufficient time for all groups to have a meaningful discussion.

204 Although the terms are used interchangeably it should be noted that feedback and debriefing  
205 are different - feedback is a one way conversation (Reierson et al. 2017). Discussion with  
206 other lecturers who facilitated the HFS sessions also summarised that the post simulation  
207 discussion tended to be lecturer feedback rather than student led. Some of the student  
208 evaluations commented upon this and that different lecturers provided different information  
209 regarding their scenario and correct care. Gantt et al. (2018) study into comparing different  
210 debriefing methods found staff and students preferred a facilitated debrief, where students  
211 and the facilitator discussed the simulation events fully, giving students opportunity to express  
212 their emotions regarding the experience and ask questions. As there were nine sessions to  
213 facilitate all the students being able to attend a HFS tutorial and each session required three  
214 lecturers to facilitate, it was difficult to ensure consistency between all the facilitators. A  
215 structured debriefing tool rather than the unstructured discussion that happened would have  
216 been beneficial to provide consistency (Secheresse and Nonglaton 2019). Using a structured  
217 debriefing tool instead of an unstructured discussion would also provide the participants with  
218 comprehensive, reflective feedback (Reierson et al. 2017). The ASPiH (2016) recommend  
219 that novice faculty members are provided with debriefing training as the skills of the debriefer

220 correlate closely the participants' satisfaction with the experience. However, within the HFS  
221 tutorial debriefing training did not occur.

222 A further theme from the student's evaluations of HFS tutorial was a frustration with some of  
223 the equipment. There were problems with one of the mannequin's network connection and  
224 therefore not reflecting its programmed physiological parameters and changes. This deducted  
225 from the fidelity of the simulation and could reduce student engagement in the situation (Cant  
226 and Cooper 2017). The INACSL Standards Committee et al. (2016) recommend using various  
227 types of fidelity to create a realistic simulation experience. However Johnston et al. (2017)  
228 found that some students still struggle to engage in simulation in an appropriate manner  
229 despite trying to make the experience as realistic as possible. Alconero-Camarero (2021)  
230 found that students had greater satisfaction with LFS, although this might be because HFS  
231 generally involves more complex clinical cases and technology which can be a barrier to  
232 learning.

233 Within the School of Nursing there is a dedicated Simulation and Skills team that develop and  
234 teach the simulation content that is taught to the students throughout their course. As the HFS  
235 tutorial was not a session designed by them, they were not involved in setting up or facilitating  
236 any of the tutorial sessions. The lecturers who facilitated and set up the mannequins each day  
237 work as part of a theoretical nursing team - although they help facilitate some of the simulation  
238 departments study days they are not involved with the design and setup of each session and  
239 are unfamiliar with troubleshooting some of the equipment. The ASPIH (2016) recommend  
240 simulation technicians are involved with the design of simulation scenarios and evaluating  
241 their effectiveness. It would have been helpful to have a member of the Simulation and Skills  
242 team involved in designing and facilitating the HFS tutorial.

### 243 Limitations

244 The INACSL Standards Committee et al. (2021) and the ASPIH (2016) have produced  
245 standards of best practice regarding simulation design, outcomes and objectives, assessment

246 and staff involvement. These were not incorporated when designing the HFS tutorial. These  
247 standards recommend using simulation as a formative assessment to assess skill sets such  
248 as teamwork, communication and leadership. Assessing the effectiveness of the HFS tutorial  
249 via the students written examination results was perhaps too broad and subject to other factors  
250 such as student individual learning styles, effecting correlation. The intention of a formative  
251 assessment is to improve learner performance (ASPiH 2016), therefore perhaps this review  
252 should have used participants' evaluation of knowledge pre and post the HFS tutorial rather  
253 than the written examination results in their summative assignment

254 The results from the HFS tutorial are from 2017/2018. This was the last year that the HFS  
255 tutorial was used due to the University staff shortages for 2018/2019 cohort and then a revision  
256 of the curriculum for 2019/2020 academic year due to the changes to the Standards for Pre-  
257 registration Nursing Programmes (NMC 2018). The module still incorporates simulation as the  
258 experience was evaluated positively by the students, however it is now a formative  
259 assessment which the students then have to write a reflective report on for their summative  
260 assessment. Due to the impact of Covid-19 and subsequent lockdowns 2021/2022 will be the  
261 first cohort of students to complete the formative simulation and write a reflective report.

## 262 Conclusion

263 In conclusion this paper has discussed using HFS tutorial to prepare undergraduate nursing  
264 students for a written summative examination. The use of HFS tutorial did not show an  
265 improvement in the student pass rates at assessment, though various identified confounding  
266 variables make direct comparisons of results difficult.

267 The INACSL Standards Committee et al. (2021) and the ASPiH (2016) provide standards for  
268 simulation design which would need to be incorporated for further HFS tutorials. Student  
269 evaluations of the HFS tutorial indicated that they enjoyed the teaching session. There were  
270 some areas that could have been improved such as using a debriefing tool during the  
271 debriefing discussion and having a sufficient amount of time allocated for this. A member of

272 the Skills and Simulation team should also be involved in designing and facilitating the HFS  
273 tutorial.

274 The use of HFS tutorials needs to be developed further incorporating the changes to HFS  
275 tutorial design discussed to make more significant conclusions about their impact on  
276 improvements to students learning. The HFS tutorials student participants' results and  
277 evaluation data would need to be reviewed to provide continuous ongoing areas for the HFS  
278 tutorial to be improved (ASPiH 2016).

279 Manuscript Word count: 2914 excluding references, abstract, keywords, key points and  
280 reflective questions.

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370 The evaluation from given to students to complete post their HFS tutorial.

	<b>Strongly agree</b>	<b>Agree</b>	<b>Neither agree or disagree</b>	<b>Disagree</b>	<b>Strongly disagree</b>
<b>I found the simulation on Sepsis in the lecture theatre to be engaging, informative and relevant to the module.</b>					
<b>Comments:</b>					
<b>I found the simulation session that I attended to be engaging, informative and relevant to the module.</b>					
<b>Comments:</b>					
<b>I found the simulation session that I attended to be helpful to help me understand my summative assignment</b>					
<b>Comments:</b>					
<b>I found the feedback discussion to be valuable for my learning.</b>					
<b>Comments:</b>					
<b>I feel I was able to contribute to feedback discussions regarding myself and my colleagues.</b>					

**Comments:**

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**Any other comments:**