

**THE CATALYTIC EFFECT OF A HIGH- FIDELITY SIMULATION
CENTRE ON ORGANISATIONAL LEARNING CLIMATE:
Development of an evaluation instrument [MODEST]**

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ABSTRACT

CONTEXT

The use of technology-enhanced and high-fidelity simulation as a teaching method has become increasingly popular within the health professions, but its effectiveness remains uncertain. However, we hypothesised that there might be a measurable effect on the wider learning climate of the host organisation. There currently exists no testing instrument with which to measure the extent to which the learning climate of a Trust is stimulated by the presence of such centres. Our objective was to develop this instrument [MODEST: Measure Of the Diffusion Effects of Simulation Training) for future research and evaluation.

METHODS

Following a literature review, we conducted a series of face-to-face interviews with medical professionals at two London Hospitals (n=34) to identify the main themes. We then developed a series of online questionnaires (for a: users of the simulation centers, b: simulation centre managers and c: heads of department within the Trust), which were piloted in February-June 2011. They were also piloted amongst Yorkshire Hospitals in May 2012 before a further wave of tests in June-July 2012.

RESULTS

The final round of piloting (n=35) covered a wide range of organisations, health care professions, clinical specialties and grades, as well as a range of experience of using simulation centres. This allowed for a spectrum of feedback, which fully tested the limits of the questionnaire. No difficulties in completing the questionnaire were reported, and as such a finalised version was developed.

CONCLUSIONS

The main aim of the study - the development of the tool - was achieved, allowing us to begin to identify the effects of the new simulation centre on the learning climate of the hospital in general; individuals were able to identify the value of the simulation

centre, indicating that it could fill gaps in curricula. On this basis, wider use of this tool will demonstrate its robust applicability across a range of environments.

INTRODUCTION

In 2009, the Centre For Medical Education in Context, (CenMEDIC) along with the West Middlesex University Hospital (WMUH) was commissioned by the London Deanery's Simulation and Technology-enhanced Learning Initiative (STeLI) to examine the effects of the hospital's high-fidelity simulation centre on the organisational learning climate of the Trust, and to develop a tool for measuring the impact and wider effects of simulation facilities on learning in healthcare organisations in general.

The development of this tool was prompted by and contingent on two distinct factors. First: in recent years, the use of simulations (including clinical simulators, which range from training mannequins and individuals acting the role of patients to high-fidelity computer-activated equipment, ICT and audio-visual materials offering virtual patients and cases) has gained widespread popularity in the healthcare professionsⁱ. However, the true effectiveness of these simulations in aiding the acquisition of knowledge and skills remains uncertain^{ii,iii} – evidence for its effectiveness is gradually being accumulated, but is far from complete [Thomas, 2013]^{iv}. Simulation generally takes place away from the clinical area in a dedicated place, and provides varying levels of fidelity for different education purposes.

The wide variety of jeopardising variables, individual differences, prior and subsequent learning and experience, and practice contexts have made it difficult to prove an objective causal relationship between any form of training and actual practice in medicine^v. This has largely proved to be the case in relation to simulation. Nonetheless, there is need to study its effect in general across all situations. So rather than continuing to try to conduct effective outcomes studies, we took a different view and decided to formulate a tool to demonstrate the value-for-money of

simulation training, the ways whereby it can be enhanced, and – most significantly – its effect on the educational environment and organisational learning climate of the hosting institution as a whole.

A word on organisational learning climates (OLC): following Kurt Lewin's (1951) classical observation^{vi} of the relationship between the individual and the environment, the concept of the OLC concerns the link between the educational needs of the individual and those of the organisation as a whole. These were later reconceptualised in terms of a learning milieu^{vii}, arching around such concepts as, for example, administrative flexibility (especially regarding individual learners in difficult situations), the question of concept vs. detail, educational facilitativeness, the friendliness of the atmosphere, students' involvement in curriculum planning and vocational vs. 'scientific' orientation, amongst many others. In short, the OLC can be viewed as an interconnected web of individual and organisation, with each affecting the other. The introduction of a new learning tool is liable to have a significant and – theoretically – measurable catalytic effect on the OLC as a whole.

Baumfield *et al*ⁱⁱⁱ. define this 'catalytic' effect in terms of a 'positive dissonance'- the ability of a new tool (in this case, simulation training) to shake up the existing traditions and routines of an environment and, in doing so, break up any calcifying or impeding agents against change. These new tools do not merely prompt change in and of themselves, they positively reframe all aspects of the environment – "it can change the composition of other agents in the environment or organisation whilst maintaining stability by not being changed itself" In effect, classroom practice is linked to institutional improvement (see also: Fullan^{ix}).

The aim of this project was, in short, to develop a tool to measure and describe the catalytic effects of simulation centres on an organisational learning climate – the

extent to which new educational activities and concepts are generated by a simulation centre, whether at the level of the organisation, sectors of that organisation (departments or groups), or individuals within that organisation (individual trainees or trainers). In addition to this, we aimed to be able to identify new education activities that occurred as a direct or indirect result of the presence of the centre, and to provide a basis of comparison across Trusts [hospitals] with different types of simulation equipment.

The immediate context of the study was the recently developed simulation centre at WMUH, which provided a perfect test-bed for the project. Further comparison with other sites at a more mature stage could ensure that we identified more 'steady-state' characteristics and effects.

By identifying the types of educational activity stimulated by the presence of a simulation centre, other Trusts would also be able to monitor and support this activity and assume its development when undertaking cost-benefit studies of simulation centres.

METHOD

The methodology of constructing the tool was based on two broad strands. The first was descriptive: collecting data on educational activity, awareness and potential as a result of a simulation facility. The second phase was constructive: using the collected data to develop the tool to measure the educational climate catalysed by the presence of simulations.^x The various sub-steps are tabulated below:

STEP	PURPOSE	OUTCOME
Literature review	To determine whether similar work had been done, and to identify variables to be addressed in the survey.	Overview of issues and precedents
Semi-structured interviews with administrators, teachers and learners.	To identify issues for the survey, and to capture respondents' own 'voices'	Content for the survey instrument
Development of the survey instruments	To draft a survey instrument for administrators, teachers and learners.	Draft instrument(s)
First stage piloting	To determine that the target groups could use the online questionnaire and that it was satisfactory to them.	Piloted online questionnaire
Second stage piloting with clinical tutors	To determine that this group could use the online questionnaire and that it was satisfactory to them.	Piloted and modified online questionnaire
Third stage piloting	To test acceptability of modifications and to extend the sample of testers.	Piloted and modified online questionnaire

Table 1: Methodology of Study

LITERATURE REVIEW

The first step was to conduct a literature review, both to inform the project and to identify existing tools used to measure the effect of simulation training on an educational environment. During May 2009 searches were made of the electronic databases MEDLINE, CINAHL, Web of Science and PsychInfo, using combinations of the keyword terms 'Educational OR Training OR Learning', 'Environment OR Climate', 'High-Fidelity', 'Simulation' and 'Measurement OR Instrument'. This research was updated in May 2010, submitted to the Deanery in September 2012 and re-performed in July 2012.

Many studies reviewed made use of the Dundee Ready Education Environment Measure (DREEM), a questionnaire tool developed by Roff and her colleagues at the University of Dundee and first published in 1997^{xi} - this was since adapted for use in postgraduate medicine, where it is given the acronym PHEEM (Postgraduate Hospital Educational Environment Measure).^{xii,xiii}

While both DREEM and PHEEM have been demonstrated (through many studies) as practical, valid, statistically reliable cross-cultural tools, neither suits the purposes of the current study because they do not look at the *institutional* effect of having a simulation centre within the institution. This study focuses less on specific content questions or events and more on the atmosphere of the learning environment.

The literature review confirmed our original hypothesis: while there are a number of studies where tools were used to evaluate learning within the healthcare professions, none examined the organisational catalytic effects of a simulation centre. Our development of an instrument for measuring these diffusion effects, focusing on how people interact with the new resource and whether they take the effects of that back

to their clinical practice and clinical training, as therefore an original contribution to the field of simulation.

At this point, we had established the important niche that the tool was to fill, allowing us preliminarily to define it. The proposed tool was given the acronym MODEST (Measure Of the Diffusion Effects of Simulation Training), and would be a questionnaire for use within any Trust involved in high-fidelity simulation training, providing a new approach to evaluation of the effects of high-fidelity simulation centres.

The theoretical background of MODEST now established, we then went about collecting data to define the 'real-world' content that would form the backbone of the survey instrument, to complete the 'descriptive' strand of the methodology.

SEMI-STRUCTURED INTERVIEWS

What followed was a series of semi-structured interviews with administrators, teachers and learners in the WMUH. The hospital, which had begun high fidelity simulation training by May 2009, had run one faculty training course and was about to run a second: two sessions had been completed with accident and emergency [A&E] doctors, one for SHOs and another for Specialist Registrars. There were plans to offer simulation training to the entire F1 [intern] cohort at their induction in August 2009, and for F2 [senior intern] doctors as they rotated through A&E.

Between July and August 2009, the team carried out 34 face-to-face interviews at two sites: WMUH and one other NHS district general hospital [DGH] (see table for representation across the two sites).

Interviewees	WMUH	DGH
Simulation Centre/Skills Laboratory Managers	1	1
Simulation Clinical Leads	1	1
Medical Education Directors	1	1
Consultants	3	10
Trainees	2	2
Trust Managers	3	3
Resuscitation Officers	2	1
Nurse Managers	1	1
Total	14	20

Table 2: Demographics of Interviewed Participants

The aim was to gather data about individuals' knowledge of the simulation centre (and measures of its success and failure), possible institutional effects of simulation training, the Trust's education profile – in terms of how education is planned, managed, delivered internally and externally – as well as any perceived threats to education within the Trust. Proposed questions are summarised below:

About the simulation centre's effects:
1. What do you know about the simulation centre?
2. What are you expecting the simulation centre to offer?
3. Are you involved with simulation training activity yourself e.g. as a trainer, or planner?
4. What tangible outcomes do you expect as a result of the simulation centre?
5. What difference do you expect the simulation centre to make to the Trust as a whole?
6. How do you expect success/failure to be measured?
About general educational activity in the Trust:
1. What is the current profile of education in the Trust? What importance is placed on education in the Trust?
2. What educational activities are you involved in?
3. Are you involved in educational planning in the Trust?
4. Have you noticed any new educational activity recently?
5. How is education in the clinical setting approached here?
6. What do you perceive to be the main threats to education in the Trust?

Table 3: Proposed questions

Comprehensive notes were taken at the time of each interview and written up by the interviewer as soon as possible afterward.

Data were analysed by three researchers using a robust content analysis method^{xiv}, which enabled them to develop the main themes (events, problems, views, strengths, experiences, needs, etc) that emerged. For each agreed theme, indicative quotations and examples were selected and the incidence of each theme in the interviews recorded, allowing main themes and sub-sets of illustration to be identified. Each researcher worked with the others to check their own understanding and to cross-check details and interpretation with the original interviewer. Using this method, the qualitative data were converted into robust, quantitative, illustrated results, the generalisability of each part of which could be estimated and used to inform the development of the survey instrument.

This analysis indicated that the extent to which a simulation centre catalytically affects an OLC can be split into four main strands:

Knowledge of the Centre

- whether interviewees were aware the training was happening, how it was funded, what equipment/facilities were available, how they were introduced (via email or meetings) to the concept, the extent to which clinical leads were trained in using the centre and developing scenarios for learners, as well as a perceived confusion between a 'simulation centre' and a 'skills lab'.

Perceived benefits and limitations of the centre

- discussion of topics that could be taught and particular clinical areas that could be concentrated on, the perceived positive education benefits of the centre and

associated logistical/educational/fiscal factors, as well as the various tangible outcomes of the centre, including improvement of the confidence of junior staff and improved patient care. Limitations were identified in terms of administrative and logistical difficulties and a lack of evidence of its effectiveness.

Measuring the centre's success and failure

- suggestions for how the success/failure of the centre could be quantitatively measured, including measuring satisfaction of trainees, patient care factors, numbers of courses that are run, comparison of confidence/competence of trainees before and after training, numbers of staff attending courses, reputation of the trust, staff retention, economic factors and popularity of the courses.

Education Context

- a more generalised discussion of education's place within the Trust, including consideration of the high importance placed upon education with a Trust, the educational courses available, the means in which education can be delivered within a Trust, and threats to education within the trust, including time constraints, lack of staff, lack of space and insufficient equipment.

The development of these four strands allowed us to develop a way of measuring the extent to which education activity is stimulated, and as such showed that we could develop a preliminary version of the MODEST survey instrument to track the diffusion of educational effect throughout the Trust.

DEVELOPMENT OF PRELIMINARY VERSION OF MODEST

Using the SurveyMonkey software, we developed an online questionnaire predominantly for those who trained at or taught in the simulation centre. Two further questionnaires were also created: one for simulation centre managers /

administrators and the other for Heads of Departments within the Trust. This version was formed of multiple choice questions and rating scales, with skip questions to lead respondents through the questionnaire according to their experience with the centers. Free text was avoided, although respondents could contact the team directly if they had further comments or preferred a paper study. Branch questions separated the responses of learners and trainers. The content of MODEST breaks down into three main sections:

<i>INTRODUCTION</i>
<ul style="list-style-type: none"> • Demographic of the respondent, whether they are aware of Simulation Centres in the Trust, and how they heard about the Centre.
<i>COURSES</i>
<ul style="list-style-type: none"> • The respondent's level of involvement - as a teacher or a learner, and how many courses were attended, types of skills learned and improved, the extent to which the centre fills (or doesn't fill) gaps in the curriculum, and how the Centre responds to real education needs within the Trust.
<i>EFFECTS OF THE CENTRE</i>
<ul style="list-style-type: none"> • What aspects of the departmental training have been affected by the use of the Centre, how it affects teaching in the department as a whole, as well as considerations about how the simulation centre works logistically, in terms of timings and on/off site training.

TABLE 4: Preliminary Structure of MODEST Questionnaire

FIRST STAGE PILOTING

The aim of this stage was to test MODEST's ease-of-use. It took place in February 2011-May 2011 amongst individuals who had been contacted via the Postgraduate Centre at WMUH. The questionnaire was also forwarded to individuals at a Foundation Trust in east London, and, in April 2012, to participants from several Yorkshire Hospitals, recruited through the National Association of Clinical Tutors. This brought the total number of respondents up to 33.

This small-scale, multi-centre sample into the ease-of-use of MODEST was successful; the pilot suggested that MODEST was mostly intuitive and comprehensible, while the wide range of answers suggested that it enabled respondents to offer their opinions. However, individual respondents highlighted difficulties in completing parts of the questionnaire and confusion in the wording of some of the questions.

This allowed the team to modify the questionnaire: for example, the question 'How many courses have you attended as a learner or as a trainer', with a free text response was changed to 'How many *sessions* have you attended', with a structured multiple-choice matrix for responses. The team also added filter questions and skip directions to response choices, allowing people to only answer the questions that were most relevant to them.

The responses from the individual questionnaires for simulation centre managers / administrators and the other for heads of departments within the Trust similarly showed that the tool was useable and comprehensible. As the content and responses from the administrator questionnaire differed very little from the main survey instrument, it was decided that the separate Administrator Questionnaire was probably not merited.

SECOND WAVE PILOTING

The updated version of MODEST was piloted in Summer 2012, to test the redesigned aspects and to seek responses from those underrepresented in previous stages of developments. There were responses (n= 35) from a range of organisations, health care professions, clinical specialties and grades. No difficulties in completing the questionnaire were reported and therefore MODEST was finalised and completed.

RESULTS

The fully developed MODEST questionnaire contains the following items, which differentiate between skills laboratories and simulation centres:

1.	Demographics
2.	Awareness of the skills lab
3.	Use of the skills lab as a learner or trainer
4.	Skills practised in the skills lab as a learner
5.	Skills practised in the skills lab as trainer
6.	Awareness of the simulation centre
7.	How information was given about the simulation centre
8.	Whether the respondent has used the simulation centre
9.	Use of the simulation centre as a learner
10.	Frequency of use of the simulation centre
11.	Skills practised in the simulation centre as a learner
12.	Use of the simulation centre as a trainer
13.	Frequency of use of the simulation centre as a trainer
14.	Skills practised as a trainer
15.	Contribution of the simulation centre to training in the respondent's specialty
16.	Sufficiency of the specialty training programme outside the simulation centre
17.	Areas requiring further educational provision
18.	Response of the simulation centre to educational needs in the Trust
19.	Effects of being a simulation centre trainer on wider educational skills
20.	Effects on being trained in the simulation centre on non-clinical skills
21.	Which aspects of departmental teaching have been affected by the simulation centre

22.	Mechanism by which departmental teaching has been influenced by the simulation centre
23.	Students' perceptions of how departmental teaching has been influenced by the simulation centre
24.	Specific teaching skills which have been affected by the simulation centre
25.	Importance of the safe environment in the simulation centre
26.	Effect of the simulation centre on service, education and costs
27.	Quality of team working
28.	Effects of the simulation centre on team working
29.	Ability to attend training sessions on-site and off-site
30.	Effects of the simulation centre on accessibility of training sessions
31.	Time spent off-site as a trainer
32.	Time spent off-site as a learner

Table 5. Content of MODEST

CONCLUSIONS

Overall, the project achieved its main aim of developing the MODEST tool, for measuring the impact and wider effects of a simulation facility on learning in healthcare organisations across the UK. MODEST can be used by established simulation centres to measure the effect on education practice in the wider institution, as well as by new or planned centres to provide a baseline and developmental measure of the diffusion of education ideas. It can also be used to compare diffusion effects of varying levels of fidelity and complexity within different institutions, as well as within interprofessional practice.

MODEST provides a validated and systematic approach to evaluation and research in relation to the organisational learning effects of simulation centres. Additionally,

recent literature reviews showed that while technology-enhanced simulation training is consistently associated with large effects for outcomes of knowledge, skills and behaviours, the effects for patient-related outcomes are less well pronounced.^{xv}. MODEST can contribute to explanation fo such effects or lack of effect. MODEST can also be used to further explore ideas of changing self-concept as an educational provider.

MODEST is freely available on application to CenMEDIC.

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