Use of simulators in operative dental education: experience in southern Nigeria

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Abstract:
Background: Though the use of simulators in operative dentistry is not new, the teaching and learning practices that take place during clinical sessions in skills laboratories are rarely reported. This study was designed to determine the current practices relating to teaching and learning of dental clinical skills in southern Nigeria.

Methods: A cross-sectional study was conducted among the final year dental students in southern Nigeria using anonymous structured questionnaire as instrument for data collection. The questionnaire items included statements relating to existing teaching and learning practices. A five-point Likert scale response option was provided and descriptive summary statistics was computed.

Results: There were 56 (34.8%) females and 105 (65.2%) males. Most of the students (41.0%) agreed that the theoretical concept behind clinical skills is taught prior to clinical sessions and most agreed that the objectives of each clinical session are stated and that the procedures are usually demonstrated. Most of the respondents (39.8%) agreed that feedback was sometimes embarrassing and given at the end of clinical sessions (76.6%). Equipment breakdown was a major challenge to learning.

Conclusion: Dental education in the skills labs within the region appeared standard. However, feedback should be continuous and constructive. Equipment breakdown was the major constraint to learning.

Key words: Simulators, Dentistry, Clinical skills laboratories, Dentistry, Simulators

DOI: http://dx.doi.org/10.4314/ahs.v15i1.35

Introduction
In clinical operative dental practice, one of the most important skills a dentist must have is the ability to prepare and restore damaged tooth tissue resulting from caries or non-carious lesion, trauma, etc. Knowledge of the concept of tooth preparation and restoration and the dexterity to carry out the procedure are basic requirements for successful restorative dental treatment¹². It is imperative that dental students acquire appreciable degree of competence in the area of hand piece and dental materials manipulation, patient and mouth mirror positioning, cross infection control as well as restorative dental procedure prior to exposure to real life clinical practice³. Failure to achieve this may lead to irreversible tooth morbidity and unnecessary tooth mortality. Iatrogenic tooth damage is a common finding in some aspects of restorative dental interventions⁴⁵⁶.

Therefore, concerns over patient safety have led to a decrease in the popularity of the practice whereby students practice new skills on patients²⁷. This has led to an increasing use of simulators in health care education programmes. These may be related to the intense concerns for patients’ safety by stakeholders, technological advancements and the realization that the clinical setting is not an ideal environment for learning new clinical skills. In a simulated clinical setting for example, novice dental students can operate on mannequin/phantom heads equipped with jaws and synthetic teeth as well as tooth drilling apparatus to learn and master technical skills required for tooth restoration prior to treating patients thereby transforming them into practicing professionals. The transformation process is designed to help students learn how to collect data, interpret and synthesize findings, evaluate critically the effect of actions taken, perform procedures skillfully, and relate to patients in an ethical and caring manner²⁵⁸⁹.

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Effective clinical teaching requires not just clinical skills on the part of the instructors but also, knowledge of general principles of teaching and learning. Teaching and learning practices that enables a novice dental student to transform to an independent and professional oral health care provider has been described as an important central business of dental educators. Medicine and Nursing are said to have a literature rich in discussion on student learning in clinical practice, but in Dentistry that literature is almost non-existent. Jensen et al. (2008) reported further that instructional techniques and personal experiences with the use of dental clinical skills laboratories were rarely documented.

At the moment, the teaching and learning practices that currently take place in Nigeria between dental students and their instructors during practical sessions in clinical skills laboratory has not been reported. The aim of the current study was to determine the current practices in teaching and learning dental operative clinical skills in Southern Nigeria dental schools’ clinical skills laboratories and to identify the challenges to effective learning experience in dental schools’ clinical skills laboratories.

Materials and method

This was a cross-sectional study involving final year dental students in Southern Nigeria dental schools. The southern part of Nigeria is relatively more developed socio-culturally than the northern region and all the dental schools in Nigeria but one are located in the region. The dental schools in this region are strategically located in the cities of Ife (Obafemi Awolowo University), Benin (University of Benin), Lagos (University of Lagos) and Ibadan (University of Ibadan). Others are Enugu (University of Nigeria) and Port Harcourt (University of Port Harcourt).

All the final year dental students in the six dental schools located in the region were enrolled. Students who were not available at the time of the study, who declined participation and those who failed to respond after two or three reminders were excluded from the study. An anonymous structured questionnaire (Appendix A) was employed as the instrument for data collection. The questionnaire items were developed following a focus group discussion among the final year dental students of University of Port Harcourt. The focus group discussion was to explore the students’ ideas, perceptions and experiences as regards teaching and learning of clinical skills in simulator learning environment. The areas covered included: existing teaching and learning practices in dental skills laboratory, the challenges and issues relating to transferability of skills from skills laboratory to real clinical practice. During the discussion, all participants were given the opportunity to discuss freely about teaching and learning methods, challenges and personal experiences in simulator skills laboratories. The interviews was recorded on audio tape (with group permission) and later transcribed for analysis.

A five-point Likert scale response options was provided as follows: Strongly Agree=5; Agree=4; Undecided=3; Disagree=2; Strongly Disagree=1. The instrument was pretested among the nine final year students of University of Port Harcourt for clarity and understanding of concept after content/logical validity evidence had been done by two consultant dentists who have had formal training in biomedical education. However, validity coefficient was not calculated. The questionnaires were administered in UNN and UNIPORT by one of the authors and by contact persons not participating in the study in other schools. Each questionnaire has a brief summary of what the study was all about. Before the commencement of the study, ethical clearance was obtained from University of Port Harcourt College Research Ethics Committee.

Statistical analysis

The data was entered into a micro computer and analyzed using SPSS for Windows version 16.0, (SPSS Inc Chicago Illinois, USA). Descriptive statistics was performed on all the questionnaire items.

Results

One hundred and eighty two questionnaires were administered out of which 161 were properly filled and returned to the investigator giving a response rate of 88.5%. Highest number of respondents was recorded from Universities of Benin and Ife. Thirty- six respondents (22.4%) participated from each of these Universities (Table 1).

The least number of respondents came from university of Port Harcourt where there were only nine (5.6%) respondents. Out of the 161 respondents, there were 56 (34.8%) females and 105 (65.2%) males. The age range of the respondents was 21–38 years and the mean was 25.73 years (SD±2.484).

When the statements about operative clinical session were analyzed, most of the respondents (44.7%) strongly agreed that the theoretical concept behind the clinical practice on simulator is usually taught in the class room (lecture) before the practical session begins and this was closely followed by those who simply agreed with the statement (41.0%). Seventy-five respondents (46.6%) agreed that the instructor normally states the objectives of each clinical training session while 53 (32.9%) strongly agreed that the objectives were normally stated. Most of the respondents (43.5%) strongly disagreed with the intuition that the clinical session is usually preceded by video demonstration and this is followed by those who disagreed (25.5%). The distribution of the participants’ responses as regards the statements on whether the instructor normally demonstrates the clinical session to the whole class and sub groups followed the same pattern respectively. Most of the respondents in both cases agreed that the instructor normally demonstrates the procedure before the clinical session.

Ninety respondents (55.9%) agreed that the instructor normally describes the steps involved in each clinical session. Only 27.3% strongly agreed with this assertion. The views of the respondents as regards whether the instructor always ensures that each student knows exactly what to do before the clinical session begins appeared concentrated between disagree and agree points. Twice the number of respondents (16) who strongly agreed that the instructor always ensures that each student know exactly what to do before the clinical session begins disagreed with this assertion and about half (32)

| Table 1:  | Socio demographic characteristics of the students |  |
| Variables | Frequency | Percentage (%) |
| Gender | | |
| Male | 105 | 65.2 |
| Female | 56 | 34.8 |
| Address | | |
| Benin | 36 | 22.4 |
| Enugu | 21 | 21 |
| Ibadan | 32 | 19.9 |
| Ife | 36 | 22.4 |
| Lagos | 27 | 16.8 |
| Port Harcourt | 9 | 5.6 |
| Total | 161 | 100.0 |
the number of those who agreed with this assertion (59) disagreed with it. The number of respondents (75) that agreed that the instructor gave feedback at the end of the clinical session was more than those who agreed that the instructor gave continuous feedback (60) and the number of respondents who were undecided regarding whether the instructor provides continuous feedback was more than those who were undecided regarding whether the respondents provides feedback at the end of clinical session. The result on whether the instructor encourages peer review (review by fellow students) showed that most of the respondents agreed (37.9%) with this assertion. However, the proportion of those who were undecided (23.6%) was very close to the proportion of those who disagreed (21.7%).

Sixty-four respondents agreed that the instructor feedback was sometimes discouraging and this was followed by those who were undecided (48). The number of respondents who disagreed (50) with the assertion that the instructor gives each student enough attention was slightly higher than the number of those who agreed (48). Most of the respondents (46.6%) strongly agreed that frequent equipment/instrument breakdown is a major challenge in the learning process on simulators and this was closely followed (31.7%) by those who agreed with this statement. The number of respondents who were undecided and who disagreed with the assertion that technicians responded promptly to call for assistance when equipment broke down during clinical session was the same (41). However, most of the respondents agreed with the insinuation that technicians did respond promptly to call for assistance during clinical session.

Most of the respondents (46.6%) agreed that student performance is usually graded during practice session and in the distant second position were those who strongly agreed with this position. The proportions of respondents who disagreed with and who were undecided regarding the grading of students’ performance during clinical session were the same (16.1%) and very close to the proportion (18.6%) of those who strongly agreed with this assertion. Only 18.6% of the respondents strongly agreed that the skills acquired on simulator were easily transferable to clinical practice whereas 40.4% participants representing the highest agreed that the skills were easily transferable. About one-third of the respondents were at most undecided about transferability of skills from clinical skills centre.

Apart from the respondents from the Universities of Benin and Lagos who had a median score of 3 (undecided) and 3.5 (approximately 4) respectively (fig 1), all others recorded a median score of 4 (agree). This suggests that most of the respondents agreed that the skill acquired on simulator was easily transferable to real life clinical practice irrespective of the training institution.

### Table 2: Students’ views and learning experiences in dental operative clinical skills laboratory N=265

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Strongly Agree (%)</th>
<th>Strongly Disagree (%)</th>
<th>Disagree (%)</th>
<th>Undecided (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. The clinical table before the clinical practice on simulator is usually taught in the class meeting (lectures) before the practical session has created a wide interest in clinical simulation, and recently there has been a considerable expansion in number and complexity of simulators applicable in the field of dental education18. This study presents an overview of teaching and learning methods, challenges and personal experiences in Southern Nigeria dental schools’ simulator laboratories. The age distribution of the students involved in this study was similar to that reported by Burch et al. (2011)14 and Ehizele et al. (2011)15. However, smaller number of females was involved in the current study compared to the previous studies. The relatively newer dental schools in the region: Port Harcourt and Enugu had limited capacity and expectedly had smaller number of respondents. Regarding whether the theoretical background behind the clinical skills, is usually taught or not in the classroom before the practical session, our result shows that most of the students strongly agreed that the theoretical concept behind the clinical practice on simulator is usually taught in the class room (lecture) before the practical session begins. This corroborates the previous results reported by Burch et al. (2011)14 and Ehizele et al. (2011)15.</td>
<td>72.44</td>
<td>3.61</td>
<td>8.85</td>
<td>3.20</td>
</tr>
<tr>
<td>2. The instructor normally states the objectives of each clinical training session</td>
<td>73 (29.9)</td>
<td>7 (2.7)</td>
<td>19 (7.3)</td>
<td>20 (7.8)</td>
</tr>
<tr>
<td>3. The clinical session is usually preceded by video demonstration</td>
<td>7 (4.3)</td>
<td>14 (8.7)</td>
<td>29 (18.0)</td>
<td>41 (25.5)</td>
</tr>
<tr>
<td>4. The instructor normally demonstrates the clinical sessions to the whole class</td>
<td>6 (2.3)</td>
<td>7 (2.7)</td>
<td>17 (10.6)</td>
<td>16 (9.9)</td>
</tr>
<tr>
<td>5. The instructor normally demonstrates the clinical session to sub groups</td>
<td>3 (1.2)</td>
<td>7 (2.7)</td>
<td>20 (12.4)</td>
<td>22 (13.7)</td>
</tr>
<tr>
<td>6. The instructor normally describes the steps involve in each clinical session</td>
<td>4 (1.5)</td>
<td>9 (3.5)</td>
<td>18 (11.2)</td>
<td>9 (5.6)</td>
</tr>
<tr>
<td>7. The instructor always ensures that each student knows exactly what to do before the clinical session begins</td>
<td>16 (6.2)</td>
<td>59 (22.4)</td>
<td>43 (26.7)</td>
<td>32 (19.9)</td>
</tr>
<tr>
<td>8. The instructor provides continuous feedback to the students</td>
<td>18 (6.9)</td>
<td>60 (22.9)</td>
<td>50 (31.3)</td>
<td>24 (14.6)</td>
</tr>
<tr>
<td>9. The instructor provides feedback to the students at the end of the clinical session</td>
<td>15 (5.8)</td>
<td>75 (28.6)</td>
<td>37 (22.0)</td>
<td>29 (18.0)</td>
</tr>
<tr>
<td>10. The instructor encourages peer review (review by fellow students)</td>
<td>16 (6.2)</td>
<td>61 (23.4)</td>
<td>38 (23.6)</td>
<td>35 (21.7)</td>
</tr>
<tr>
<td>11. The instructor’s feedback is sometimes discouraging and embarrassing</td>
<td>19 (7.2)</td>
<td>48 (18.6)</td>
<td>48 (29.8)</td>
<td>25 (15.5)</td>
</tr>
<tr>
<td>12. The instructor gives every student enough attention</td>
<td>15 (5.8)</td>
<td>48 (18.6)</td>
<td>26 (16.1)</td>
<td>40 (24.3)</td>
</tr>
<tr>
<td>13. Frequent equipment/instrument breakdown is a major challenge in the learning process on simulators.</td>
<td>75 (28.6)</td>
<td>51 (19.8)</td>
<td>42 (25.5)</td>
<td>46 (28.0)</td>
</tr>
<tr>
<td>14. The students are provided with enough time to critically assess the simulation</td>
<td>11 (4.3)</td>
<td>48 (18.6)</td>
<td>41 (25.5)</td>
<td>41 (25.5)</td>
</tr>
<tr>
<td>15. Student performance is usually graded during practice session</td>
<td>30 (11.5)</td>
<td>75 (28.6)</td>
<td>26 (16.1)</td>
<td>26 (16.1)</td>
</tr>
<tr>
<td>16. The skills are acquired on simulator is easily transferable to real clinical practice</td>
<td>30 (11.5)</td>
<td>65 (24.8)</td>
<td>31 (19.3)</td>
<td>24 (14.3)</td>
</tr>
</tbody>
</table>

**Figure 1: Distribution of the median scores in skills transferability vs. university of respondents**

- Benin
- Enugu
- Ilaboran
- Ife
- Lagos
- Port Harcourt
Most of the respondents agreed that the instructor norm-
mally states the objectives of each clinical training ses-
ton. At the beginning of clinical sessions in a simulator
learning environment, it is a standard requirement to
state clearly what the student should know or can prac-
tice exactly at the end of each session. In the study by
Gerzina et al. (2005) both staff and students agreed that
when clinical objectives for clinical sessions are
provided, students are better prepared for independent
dental clinical dentistry. Peeraer et al. (2007) also
reported that clinical sessions should be designed to
support the intended learning outcomes. Most of the
respondents in the Gerzina et al. (2005) study agreed
that stating the clinical objectives for clinical sessions
would support student preparation for their independ-
ent practice of clinical dentistry. This view was but-
tressed by Omer et al. (2010) who stated that provi-
sion of handout or study guide in which the objectives
and details of techniques involved in the different clin-
ical skills procedures are clearly stated will encourage
self-directed learning.

When the views of the respondents on whether the
clinical sessions are usually preceded by video dem-on-
stration or not were analyzed, few of the respondents
agreed that video-aided learning is a common feature of
dental student clinical practice. Our result shows that most of the respondents agreed that the instructor normally demonstrates the clinical session to subgroups. This is in accordance with standard practice. This finding was at variance with that of Fugill (2005) where majority of their respondents indicated that procedures were not often demonstrated by their instructors. Omer et al. (2010) stated that it is the responsibility of the instructor to demonstrate the skills on the simulator or using the students themselves. George and Doto (2000) reported that learners may not know what the correct task looks like if they have not paid attention to the demonstration, or if there was too much time between when the demonstration took place and his/her attempt to perform the task. Fugill, (2005) advised that clinical teachers should be encour-
gaged to make demonstration a regular practice where
students are learning new procedures, even though it does take significant time.

Our result on description of the steps involved in per-
forming a clinical skill showed that most of the re-
pondents agreed that the instructor normally describes the
tasks involved in each clinical session and a smaller number indicated that the instructor always ensures that
each student knows exactly what to do before the clin-
ical session begins. One technique that has been used successfully applied overtime in the teaching of psych-
rometer skills is the five-step method. This method is
based on psychomotor teaching principles: conceptual-
ization (the learner is made to understand why the skill
is needed and how it is used in the delivery of care);
Visualization (the preceptor demonstrates the skill ex-
actly as it should be done without talking through the
procedure); verbalization (the preceptor then re-
peats the procedure but takes time to describe in detail
each step in the process. The student is further made to
talk through the skill); practice (the students perform the
skill) and correction/ reinforcement-feedback and coaching is provided. It appears the learners were be-
ing taught using this approach.

As regard provision of feedback to students by clin-
ical instructor, we observed that more students indi-
cated that clinical instructor gave feedback at the end of
the clinical session rather than giving it continuous. This finding supports that of Peer et al. (2007) to
the extent that extensive feedback is usually given as
reported for the students of the medical faculty, Uni-
versity of Antwerp (UA). In the study by Fugill, (2005)
33% of the respondents indicated that no feedback was
provided by their instructor during clinical supervision while 15% indicated that insufficient feedback was pro-
vided. Feedback helps learner to maximize their poten-
tial and professional development at different stages of
training, raise their awareness of strengths and areas for
improvement, and identify actions to be taken to im-
prove performance (McKimm, 2009). For feedback to
be effective, it should take place at the time of the ac-
tivity or as soon as possible after so that those involved
can remember events accurately and not at the end of
the procedure as is often the case in our study (McK-
imm, 2009).

The number of respondents that at least agreed that the
instructor encourages peer review (review by fellow stu-
dents) in our study was less than half of the study sam-
ple. Martin et al. (2010) reported that peer assessment
of psychomotor skills could be an important part of
the learning process and a tool to supplement instruc-
tor assessment. In their study on peers' ability to assess
psychomotor skills, even though students could not de-
tect all errors, they assessed their peers with an average of
96% accuracy.

Most of the respondents agreed that the instructor's
feedback is sometimes discouraging and embarrassing.
It appears the operative dental instructors in Nigeria
need to adjust in this regard. Fugill (2005) reported
that feedback perceived to be incorrect by the student,
or negative feedback which is personality or ability re-
lated, may affect self-efficacy and motivation. Similarly,
McKimm (2009) reported that feedback may need to be
given privately wherever possible, especially more
negative feedback. Negative feedback should be spe-
cific and non-judgmental possibly offering suggestion
(McKimm, 2009). Clinical instructor should be aware
that sometimes feedback is not received positively by
learners however constructive it is framed and fear of
upsetting the trainee or damaging the trainee-doctor rel-
rationship is a well recognized barrier to giving effec-
tive feedback. McKimm (2009) therefore, advised clinical instructor to be sensitive to the impact of their
feedback message. A previous report suggests that stu-
dents are motivated and inspired by teachers who dis-
play compassion and demonstrate genuine interest in
them as people and in their futures as dentists.

In addition, our result shows that most of the respond-
ants disagreed that the instructor gives every student
enough attention. The reason why this is so, is not clear
at the moment. It could however be multi factorial:
over admission, failed attempt to employ self-directed
learning and non-commitment on the part of the clin-
tical teachers. Arranging practice sessions for students
in the clinical skills laboratory however, had been
described as time consuming and most difficult.
Inability of clinical teachers to give enough attention
to every student could be fallout of the arbitrary over ad-
mission noted in most Nigerian University in the recent
past making it impracticable to adequately supervise the
students as expected. It has been stated that in a cen-
tre where the ratio of students to faculty is relatively
high, making sure all students understand each lesson
and have completed the required training can be prob-
lematic. Bligh (1995) reported that over half of their
respondents felt that there were too many students in
the unit at any one time while 40% would like more
staff available to help them during the sessions. Clinical
instructors should remember that skills laboratory ena-
bles students to learn at their pace, they should there-
fore be patient with the slow learners.

Furthermore, most of the students strongly agreed
that equipment breakdown is a major challenge in the
learning process on simulator. This corroborates the
finding of Widyandana et al., (2010) where the need
to repair or replace non-functional mannequins was
regarded as one the challenges to effective learning in
clinical skills learning environment. Widyandana et al.
(2010) explained that for developing countries, man-
nikins that poorly resemble the human body and those
that are worn out may negatively affect the effectiveness
of training in the skills laboratory. Clinical instructors
and biomedical administrators must endeavour to in-
clude maintenance as part of purchase contract when
acquisition of this sensitive and expensive equipment is
being contemplated. All equipment should be in good
working condition at all times. Periodic inspection,
cleaning, maintenance of equipment should be done.
An equipment log book should be maintained for all
major equipment. Laboratories should maintain nec-
essary instructions for operation and maintenance of
equipment in the form of standard operating procedures (SOPs). Maintenance contracts including warranty cards, telephone numbers of staff to be contacted in case of equipment malfunction should be kept safely.

When equipment breakdown occurs during clinical sessions, however, the respondents noted that the technicians respond promptly to call for assistance. It is believed that this reaction will lessen the stress and frustration brought about by interruptions of practical sessions.

Regarding grading of performance during clinical sessions, most of the respondents agreed that this is usually done. It has been reported that skills training as well as skills assessment yielded higher clinical skills competence.

Curtis et al. (2007) stated that rating student performance in preclinical and clinical courses can be helpful in monitoring students’ progress. Evaluation of students’ performance with each patient and/or each course was a strategic evidence to monitor students’ performance with each patient and/or each course. This is a strategic evidence to monitor students’ progress.

Evaluation of students’ performance with each patient and/or each procedure by the supervising instructor reveals the students’ daily grade. This is a strategic evidence to monitor learners’ progress. Most of the students in a previous study agreed that continuous clinical assessment supports the development of the ability of students to reflect on the criteria for excellence and to compare their work with those of other students.

At the end of a clinical session, before revealing grades to students, the session was briefly reviewed and students were given an opportunity to express their thoughts and views on the session. However, in this study, the findings relating to teaching and learning interactions in this study were based on self-reported and subjective views of a cross-section of students. However, unlike the findings of Widyandana et al. (2010) that were based on comments and experience of students from only one school, the current report was derived from comments and experiences of students from all the dental schools in the southern part of Nigeria and is therefore less likely to be affected by local peculiarities.

Conclusion

The teaching and learning interaction that takes place between dental students and their teachers in clinical skills laboratories in the southern part of Nigeria essentially conforms to expected standards in mainstream dental education, more residency positions should be created for restorative dentistry and faculty appointment should be made more lucrative and flexible to enable more clinical experts get involved in dental education.

The teaching and learning interaction that takes place between dental students and their teachers in clinical skills laboratories was easily transferable to real clinical practice. The findings relating to teaching and learning interaction that takes place between dental students and their teachers in clinical skills laboratories essentially conforms to expected standard practices, but there are certain areas of concern. Feedback administration appeared inappropriate and it also appears that sufficient attention is not being given to all the learners. Video demonstration is virtually non-existent and frequent equipment breakdown constituted barriers to effective learning. We suggest that clinical instructors should be exposed to continuous training in biomedial education, more residency positions should be created for restorative dentistry and faculty appointment should be made more lucrative and flexible to enable more clinical experts get involved in dental education.

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References


