Practical Pre-Clinical Teaching & Learning

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ABSTRACT

A large component of any dental curriculum is hinged on ensuring that students achieve the necessary level of clinical competence in order to treat patients. A very valuable educational adjunct is the use of a pre-clinical simulation or skills laboratory. Here, students are given the opportunity (often for the first time) to apply theory in a practical sense and develop the necessary level of clinical dexterity needed to treat patients safely and with confidence. This is especially important when training dental students in fixed prosthodontics treatment modalities, which represents more advanced, lengthier and costly dental treatment options. Student learning within this educationally conducive learning environment is greatly underpinned by the theories of constructivism, experiential learning, collaborative learning and peer learning. Despite the high cost of establishing and maintaining such a simulation laboratory for dental faculties, especially in Sub-Saharan Africa, the benefits to dental education and the advantages for high quality student learning far outweigh these limitations.

Keywords*: Dental education, pre-clinical dental education, simulation skills laboratory, prosthodontics, constructivism, experimental learning, collaborative learning, clinical competence, learning environment.*

INTRODUCTION

Although a large part of the dental academic curriculum is targeted towards the acquisition of sound theoretical knowledge, its practical application remains a vital component in dental education. The success of a competency-based dental curriculum would greatly depend on students acquiring the necessary basic skills in order to practice dentistry safely and with greater confidence[1].

Practical learning and teaching begins in the pre-clinical simulation laboratory (PCSL), where students are equipped with an appropriate level of skill to apply when treating patients and offers a superior learning experience in comparison to a traditional bench-top laboratory[2]. Fixed prosthodontics treatment modalities (such as crowns, bridges, inlays, on lays, veneers, post-cores, bite splints) represent very skilled, lengthy and costly dental procedures. For this reason, dental training of these procedures is generally limited to the final year students who have acquired the necessary basic dental knowledge and level of dexterity to progress to these more specialized dental treatments. The objectives which underpin the pre-clinical fixed-prosthodontics course rest on the ability of the course to equip students with the basic theoretical knowledge and practical skills which they can use when treating patients in the clinics. Being a pre-clinical course, it represents the first time that dental students are exposed to fixed-prosthodontics treatment modalities within the undergraduate dental degree programme.

The ever-growing diversity of the student population together with greater variance in student preferences for various types of teaching and learning activities (TLA's), highlights the importance of modifying and augmenting current teaching methods in order to meet the demands of modern higher education. Embracing supplementary methods would better facilitate student learning and result in improved learning outcomes. This global paradigm shift in higher education is equally applicable to the PCSL, in which new skills are acquired based on a sound theoretical understanding and the application of that knowledge. Within the PCSL, students are afforded the opportunity of putting theory into practice. Educators are tasked with the responsibility of ensuring that all students develop a suitable level of understanding and dexterity to successfully be able to apply when treating patients in the dental clinic.

Given the high technological specificity and demands of the PCSL, the inherent financial implications of establishing and maintaining

such a simulation laboratory pose real challenges for dental faculties in their pursuit of practical, pre-clinical dental education excellence.

LITERATURE REVIEW

The PCSL is a fully equipped, simulation laboratory with individual anatomically correct and ergonomically mounted mannequins (or phantom heads) for students to practice new techniques on[3,4].It also contains all the necessary dental equipment, materials and individual monitors to facilitate learning. The role that the learning environment plays in student learning is well documented [5, 6, 7, 8, 9, 10, 11] and no less relevant to the PCSL. The PCSL is a safe and interactive, educationally conducive environment in which students have flexibility and freedom to acquire new clinical skills without the pressures associated with the clinical environment. Students are encouraged to engage with new techniques and support each other as they familiarize themselves with and develop better understandings of the procedures in a more practical sense. This emphasizes the value of experiential learning[12], collaborative learning and social learning theory[11].It has been reported that students within the pre-clinical setting rate student-to-student interaction most favorably for their own learning[13]. Not only does this indicate that there is a difference in perceptions of dental students between the clinical and pre-clinical environments, but it also shows that students are acutely aware of the importance of how the learning environment can influence their own learning – positively or negatively.

Teaching within the PCSL is very structured and uses a variety of TLA's in order to appeal to a greater variety of individual student learning styles and preferences[14]. This ensures that each student within a very diverse class has the best opportunity of developing an interest for what is being taught. The intention of this is to achieve multiply inclusiveness[7,8]as the various TLA's reinforce learning throughout the course via constant repetition and facilitating knowledge to be built upon through a constructivist approach[5,9,11]. Two valuable TLA's used within the PCSL are live practical demonstrations and procedural videos. The advantage of using instructional videos within the PCSL as an adjunct to traditional teaching methods, especially for practical pre-clinical teaching, is well known [15, 16, 17]. Supplementary media exposure of new clinical procedures to students in the pre-clinical environment is reported to reduce stress and anxiety, improve self-confidence and self-esteem, resulting in increased clinical performance of students. However, greatest benefit and student preference was reported following live practical demonstrations of the procedure [15, 18].

Educators must remain respectful, accommodating and understanding of the various psychological and demographic differences within the ever-increasing class dynamic and diverse student population. The attitude of the educator in dealing with student diversity within the PCSL is a key factor in facilitating effective student learning by using these differences as possibilities and positives and not regarding them as problems and barriers to education[19]. Acting as good role models and ensuring that students remain focused on the tasks at hand during the course are vital functions of teachers, which promotes fairness and multiply inclusiveness and are often taken for granted and not explicitly given attention to[8].

The importance of concurrent supervisor feedback of student knowledge, competence and level of expectation is a key ingredient for enhancing student learning and motivation within the PCSL – especially with the acquisition of new skills. Feedback may also facilitate a deeper approach to student learning, which manifests as a higher level of understanding and application of knowledge which is actively sought out by students[20,21].With skills acquisition, it has been reported that students learn best when feedback is timeously and effectively incorporated as part of the program, which improves learning outcomes greatly[21]. The value of formative as well as summative assessment of dental students' clinical skills is undisputed in dental education and is crucial for promoting student interest and active involvement[21, 22].

Practical pre-clinical teaching has its own set of associated problems which affects the speed at which student's progress to a level which has been deemed acceptable in terms of the outcomes of learning a new practical skill. Research has shown that dexterity is less of a determining factor of clinical competence, as long as students can successfully follow and engage with appropriate training methods[23]. Hence, manual dexterity can be significantly improved through repetition and practicing tasks which students are regularly exposed to and which are defined as a necessary outcome for their course of study. Interestingly, studies have found higher student achievements with clinical prosthodontics work than pre-clinical work[24].This finding is

encouraging and might be a reflection of the way students constructively build on the practical knowledge they attain from pre-clinical tuition and training, resulting in an increased understanding and meaning of the procedures through repetition and practice[5,9,11.] It could also represent positive intent from students to perform at higher levels as they become more cognizant of the reality of what the consequences are of possible failures of their treatments on real patients. Especially given the higher level of skills required for successful prosthodontics treatments and higher associated patient costs.

It is important to bear in mind that pre-clinical teaching (such as within the PCSL), although vital for acquiring new practical skills and ensuring patient safety during clinical education, is not a clear indicator or predicator of clinical competence[25]. The difficulty that students experience in the transition from pre-clinical to clinical work is an accepted reality of dental education. Students list an increase in problem-based learning (PBL), more pre-clinical patient exposure and better simulation techniques as key areas which could improve their ease of transition into the clinical area[26]. This would result in reduced stress and anxiety within the clinical context[26].

Making use of PBL within the PCSL has great benefit in developing student responsibility through greater independence of thought, decision making, critical thinking and active clinically-oriented learning, as a way of promoting a student-centered and self-directed approach to learning[21].It has been suggested that this experiential method of learning is the most effective manner in which students learn and elucidates the mechanism of how students can bridge the gap between theory and practice[27].In essence, this means developing theory from practice and practice from theory[14].Critical thinking gets students to learn how to think and apply knowledge by developing higher level cognitive skills in an attempt to produce life-long, independent learners[28].

The value of introducing case studies and associated discussions into the PCSL, as one example of PBL, is well known for its ability to improve critical thinking and deeper analysis of thought amongst students[14,29]. Other benefits include stimulating active teamwork and collaboration, improving decision-making skills, learning from the perspectives other their peers in a bid to challenge thought and test other viable theories and hypotheses. A case study also enables students to consider what the consequences of their actions

are and evaluate the perceived strengths and weaknesses of their proposals, considering all contextually appropriate treatment alternatives while applying the necessary level of theoretical knowledge[14].

Students seem to be fully aware of the reality of resource constraints experienced by educational institutions and how this limits their progress by negatively impacting on their learning and distracting from their educational focus - even though this is out of their immediate control[30]. Human resource constraints in practical pre-clinical teaching include a lack of sufficient clinical supervision during the course. This detracts from delivering high quality teaching and ultimately high quality student learning, as students are forced to wait to receive feedback on their work which affects the speed at which they work[31]. This problem has previously been reported, which validates the importance of a well-structured pre-clinical course by assigning enough suitably trained faculty staff to supervise students[32] within the PCSL.

Concurrently, not all supervisors have the same level of clinical ability, knowledge, confidence or interest in fixed prosthodontics procedures. Students tend to gravitate towards those supervisors for assistance and feedback, who they perceive as having the necessary clinical skills themselves and from whom they can learn most effectively. Therefore, it is the students' perception of their supervisor's clinical abilities which often influences the degree to which they engage with available supervisors in order to improve their practical abilities[33]. Other resource constraints which impact on teaching and learning within the pre-clinical environment such as the PCSL include technological deficiencies, time limitations, lack of sufficient equipment and materials and poor infra-structure[11, 21].

CONCLUSION

Notwithstanding the wide range of associated problems in presenting a practical pre-clinical prosthodontics course, as educators, our efforts must be underpinned by values such as professionalism, responsibility, accountability and respect – for our profession, our students and for the education process. It is simply not acceptable to not want to try to constantly change and improve the system in which we find ourselves, for the betterment of student learning by employing more effective teaching methods.

Such a method might be the introduction of a fully functional model of blended learning into

the pre-clinical prosthodontics course[34], or at the very least computer-assisted learning or web-based learning[35]. Making lectures, procedural videos and pre-recorded procedural demonstrations available to students online the day before specific practical procedures are to be undertaken, would save valuable laboratory time which could be more wisely invested in the development of additional key practical skills. It would allow for more time to cover a wider range of prosthodontics procedures within the PCSL, giving students a more detailed and comprehensive understanding of procedures they are likely to use in the clinics and during their dental careers. The importance of investing in more cost effective and time-saving teaching and learning technologies could not be more pertinent than it is right now, given the constant increase in class sizes. Unfortunately, this results in a decrease in available time for educators to effectively impact on student learning as much as one would like - in both the pre-clinical and clinical environments.

This might be easier said than done, as the existing technological infrastructure within African dental faculty's will need additional funding and modernization in order to meet these demands by establishing institutional readiness for proper alignment of educational growth via e-learning[35].The ever-present financial limitations of much-stretched budgets make the advantages of e-learning a very attractive proposal for the future – albeit a challenging one. Practical pre-clinical teaching and learning may be the most ideal TLA in which to initiate this, with the PCSL being ideally suited for this purpose.

Another limiting factor in making this a reality, is the lack of student accessibility to information technology and the high costs of data and internet access, especially in the African context. The current assessment culture within educational institutions (and in healthcare education in general) would also benefit from much needed restructuring, with more emphasis placed on formative assessment than summative assessment, in the hope of driving students towards a deeper approach to learning[36].

REFERENCES

[1] Jen S, Tahir R. Learning and Coping as Dental Students. National University of Singapore. CDTL Brief. 2003;6(11):1-12. Retrieved from: http://www.cdtl.nus.edu.sg/brief/v6n11/sec2.htm [Accessed on 18 May 2017]

[2] Clancy JM, Lindquist TJ, Palik JF, Johnson LA. A comparison of student performance in a simulation clinic and a traditional laboratory environment: three-year results. Journal of Dental Education. 2002; 66(12) :1331 -7. Retrieved from: https:/ /www.ncbi.nlm.nih.gov /pubmed /12521059 [Accessed on 21 May 2017]

[3] Fleck L, Engeswick LM. Facilities Reinvestment Funding Proposal – One-Time Non-Base Investment Proposal: Step 2. N.d. Retrieved from: https://www.mnsu.edu/ planning/ 10f.pdf [Accessed on 21 May 2017]

[4] Riga Stradins University, RSU Institute of Dentistry. Pre-Clinical Learning. N.d. Retrieved from: http://www.rsu.lv/eng/about-rsu/faculties /medicine-and-healthcare/faculty-of-dentistry /pre-clinical-learning [Accessed on 21 May 2017

[5] Biggs J. What the Student Does: teaching and enhanced learning. Higher Education Research & Development. 1999;18(1):57-75

[6] Vermunt JD, Verloop N. Congruence and friction between teaching and learning. Learning and Instruction. 1999;9:257-80. Retrieved from http://dspace.library.uu.nl:8080/handle/1874/18 753 [Accessed on 19 April 2017]

[7] Haggis T. Constructing Images of Ourselves? A Critical Investigation into 'Approaches to Learning' Research in Higher Education. British Educational Research Journal. 2003;29(1):89-104. Retrieved from: http://www.academia.edu/ 195141/Approaches_to_learning_research_in_h igher_education_A_response_to_Haggis [Accessed on 21 April 2017]

[8] Entwistle NJ, Petersen ER. Conceptions of learning and knowledge in higher education: Relationships with study behaviour and influences of learning environments. International Journal of Education Research. 2004;41:407-28

[9] Gravett S. Adult Learning. Designing and implementing learning events – A dialogic approach. Second Edition. 2004;31-9. ISBN: 9780627025860, e-ISBN: 9780627031496

[10] Donald J. Student Learning and Intellectual Development. Tomorrow's Professor Postings. Stanford University. 2008;1-4. Retrieved from http://ctl.stanford.edu/Tomprof/postings/405.ht ml [Accessed on 11 April 2017]

[11] Taylor DCM, Hamdy H. Adult learning theories: Implications for learning and teaching in medical education: AMEE Guide No. 83. Medical Teacher. 2013;35(11):e1-e12. Retrieved from: http://www.tandfonline.com/ doi/full/10.3109/0142159X.2013.828153?scroll =top & need Access=true [Accessed on 23 April 2017]

[12] Dunn D, Chaput de Saintonge M. Experiential Learning. Medical Education. 1997;31(1):25-8. Retrieved from: https://www.ncbi.nlm.nih.gov /pubmed/10664736 [Accessed on 22 May 2017]

[13] Jain L, Jain M, Mathur A, Paiwal K, Durai swamy P, Kulkarni S. Perceptions of Dental Students Towards Learning Environment in an Indian Scenario. Dental Research Journal. 2010;7(2):56-63. Retrieved from: https ://www .ncbi.nlm.nih.gov /pmc/articles/ PMC3177369/ [Accessed on 18 May 2017]

[14] Mc Dade SA. Case Study Pedagogy to Advance Critical Thinking. Teaching of Psychology. 1995;22(1):9-10. Retrieved from: http://www .utc.edu/walker-center-teaching-learning/ teaching-resources/ct-ps.php [Accessed on 23 May 2017]

[15] Nikzad S, Azari A, Mahgoli H, Akhoundi N. Effect of a Procedural Video CD and Study Guide on the Practical Fixed Prosthodontic Performance of Iranian Dental Students. Journal of Dental Education. 2012;76 (3):354-9. Retrieved from: http://www.jdentaled.org /content/76/3/354 [Accessed on 19 May 2017]

[16] Chi DL, Pickrell JE, Riedy CA. Student Learning Outcomes Associated with Video vs. Paper Cases in a Public Health Dentistry Course. Journal of Dental Education. 2014;78(1):24-30. Retrieved from: https://www.washington.edu /trends/files/2016/03/2014b-JDE-paper-vs-video-cases-in-DPH-course.pdf [Accessed on 18 May 2017]

[17] Fayaz A, Mazahery A, Hosseinzadeh M, Yazdanpanah S. Video-based Learning Versus Traditional Method for Preclinical Course of Complete Denture Fabrication. Journal of Dentistry, Shiraz University of Medical Sciences. 2015;16(1):21-8. Retrieved from: https://www.ncbi.nlm.nih.gov/pmc/articles/PM C4476117/ [Accessed on 19 May 2017]

[18] Jeyapalan K, Mani UM, Christian J, Seenivasan MK, Natarajan P, Vaidhyanathan AK. Influence of Teaching Strategies and its Order of Exposure on Pre-Clinical Teeth Arrangement – A Pilot Study. Journal of Clinical Diagnostic Research. 2016;10(10):93-7. Retrieved from: http://www .jcdr.net/Read XML File. Aspx?id=8677 [Accessed on 19 May 2017]

[19] Paine L. Orientations Toward Diversity: What Do Prospective Teachers Bring? 1988. Retrieved from: http://citeseerx.ist.psu.edu /viewdoc/download?doi=10.1.1.519.7950&rep =rep1&type=pdf [Accessed on 26 May 2017]

[20] Entwistle NJ. Influences on the quality of student learning: implications for medical education. South African Medical Journal. 1992;81:596-606. Retrieved from: http:// europepmc.org/abstract/med/1621169 [Accessed on 23 May 2017]

[21] Rolfe IE, Sanson-Fisher RW. Translating learning principles into practice: a new strategy of learning clinical skills. Medical Education. 2002; 36:345-52. Retrieved from: http:// citeseerx.ist.psu.edu/viewdoc/download?doi=10 .1.1.576.8579&rep=rep1&type=pdf [Accessed on 23 May 2017]

[22] Taylor CL, Grey N, Satterthwaite JD. Assessing the Clinical Skills of Dental Students: A Review of the Literature. Journal of Education and Learning. 2013;2(1):20-31. ISSN 1927-5250, E-ISSN 1927-5269. Retrieved from: www. ccsenet.org/journal/index.php/jel/article/downlo ad/18032/15104 [Accessed on 18 May 2017]

[23] Giuliani M, Lajolo C, Clemente L, Querqui A, Viotti R, Boari A, Miani M. Is manual dexterity essential in the selection of dental students? British Dental Journal. 2007; 203:149-55. Retrieved from: http://www.nature.com /bdj/ journal/v203/n3/abs/bdj.2007.688.html [Accessed on 17 May 2017]

[24] Ghasemi N, Falsafi P, Khodadoust K, Bahramian A, Ghavimi M, Ghoreishizadeh A. Evaluation of the Relationship between the Pre-Clinical and Clinical Courses Grades of Dental Students in Tabriz University of Medical Sciences. IOSR Journal of Research & Method in Education. 2016; 6(4):19-21. e- ISSN: 2320–7388. Retrieved from: http://www .iosrjournals .org/iosr-jrme/papers/Vol-6%20Issue-4/ Version-1/D0604011921.pdf [Accessed on 18 May 2017]

[25] Fugill MJ. Simulation and Student Transition in Restorative Dentistry. School of Education, University of Birmingham. 2014. Retrieved from: http://etheses.bham. ac.uk /5724/1/ Fugill15EdD.pdf [Accessed on 20 May 2017]

[26] Haralur SB, Al-Malki AE. Student perception about efficacy of preclinical fixed prosthodontic training to facilitate smooth transition to clinical context. Journal of Education and Health Promotion. 2014;3:73. Retrieved from: https://www.ncbi.nlm.nih.gov/pmc/ articles/ PMC4113999/ [Accessed on 20 May 2017]

[27] Lincoln MA, McAllister LL. Peer learning in medical education. Medical Teacher. 1993;5:17-25. Retrieved from: https://www.ncbinlm. nih.gov/pubmed/8326841 [Accessed on 22 May 2017]

[28] Tsui L. Fostering Critical Thinking through Effective Pedagogy. The Journal of Higher Education. 2002;3(6):740-63. Retrieved from: http://dx.doi.org/10.1080/00221546.2002.1177 7179 [Accessed on 23 May 2017]

[29] Popil I. Promotion of critical thinking by using case studies as teaching method. Nurse Education Today. 2011;31:204-7. Retrieved from: http://www.nurseeducationtoday.com/ article /S0260-6917(10)00111-5/abstract [Accessed on 23 May 2017]

[30] Henzi D, Davis E, Jasinevicius R, Hendricson W. North American Dental Students' Perspectives about Their Clinical Education. Journal of Dental Education. 2006;70(4):361-77. Retrieved from: http://www.aalgroup.org

/uploads/files/aal_northamericandentalstudents. pdf [Accessed on 19 May 2017]

[31] Field MJ. Dental Education at the Crossroads – Challenges and Change. Institute of Medicine (US); Committee on the Future of Dental Education. Washington (DC): National Academies Press (US). 1995. ISBN-10: 0-309-05195-9

[32] Ahmed A, Hasan M, Shahnawaz A. Pre-Clinical Operative Dentistry: Students Viewpoints. Pakistan Oral & Dental Journal. 2011; 31(2): 447-52. Retrieved from: http://web. A .ebscoho st.com /abstract? Direct =true& profile =ehost &scope=site&authtype=crawler&jrnl=1012870 0&AN=71528484&h=xMhAvRLqHut1WeYC qSEjjoggCy0NU5y0WxGg7g5X20MuaGUYlf GDq63ODyaQlXnKQBLsu9DG0XIrv7ypMnL A6A%3d%3d&crl=f&resultNs=AdminWebAut h&resultLocal=ErrCrlNotAuth&crlhashurl=log in.aspx%3fdirect%3dtrue%26profile%3dehost %26scope%3dsite%26authtype%3dcrawler%2 6jrnl%3d10128700%26AN%3d71528484 [Accessed on 19 May 2017]

[33] Sweet J, Wilson J, Pugsley L. Chairside teaching and the perceptions of dental teachers in the UK. British Dental Journal. 2008;205:565-9. Retrieved from: http://www.nature.com /bdj/ journal/v205/n10/full/sj.bdj.2008.983.html [Accessed on 18 May 2017]

[34] Reissmann DR, Sierwald I, Berger F, Heydecke G. A Model of Blended Learning in a Preclinical Course in Prosthetic Dentistry. Journal of Dental Education. 2015;79(2):157-65. Retrieved from: https://www.ncbi.nlm.nih.gov/pubmed/256406 20 [Accessed on 19 May 2017]

[35] Frehywot S, Vovides Y, Talib Z, Mikhail N, Ross H, Wohltjen H, Bedada S, Korhumel K, Koumare AK, Scott J. E-learning in medical education in resource constrained low- and middle-income countries. Human Resources for Health. 2013;11(4). Retrieved from: https:// human-resources-health.biomedcentral. com/articles/10.1186/1478-4491-11-4 [Accessed on 21 May 2017]

[36] Rushton A. Formative assessment: a key to deep learning? Medical Teacher. 2005;27(6):509-13. Retrieved from: http://dx.doi.org/ 10.1080/ 01421590500129159 [Accessed on 26 May 2017]