Preventing decay: A collaborative partnership between students and staff to prevent deterioration of dental undergraduate practical skills

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Abstract

In 2012 a collaborative staff-student partnership was formed at The School of Dentistry, Cardiff University, to address concerns that an inflexible curriculum and difficulties finding suitable patients frequently led to long delays between dental students learning practical skills in a skills laboratory and carrying out the same tasks on a patient. This led to students becoming deskilled and losing confidence. The aim of the project was to enable learners and clinical teachers to work together to develop a flexible (but focused) new resource for learning in this context. The local success of the project was evidenced by the high level of student uptake of the new resource, increased student confidence, and demonstration of transfer of learning from a skills laboratory to a clinical

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setting. However, impact was also achieved in the wider context at institutional level in terms of a change in the philosophy of how practical skills should be taught in dentistry.

Key words: Skills retention, flexible learning, students as partners

Introduction

Traditionally, dental undergraduates learn practical skills on manikins in a skills laboratory. Dental curricula tend to follow a conventional approach to learning, with essential clinical skills taught in fixed 'blocks' of instruction before students carry out the same skills on a patient. The deterioration of knowledge and skills that occurs following non-use over time is well known (Arthur et al 1998; Farmer et al 1998) and can be a significant problem, particularly in healthcare settings (McKenna & Glendon 2011). The inflexibility of traditionally delivered curricula compounds these difficulties. The main driver for this project was an earlier piece of research that was undertaken as part of an MSc in medical education that focussed on the factors affecting transference of dental practical skills from a skills laboratory to a clinical setting (Jenkins 2012). The original study explored the perceptions of two different stakeholder groups (learners and teachers) across a range of themes, with the purpose of gathering data sets that could be used to inform future practice.

One of the main outcomes of the original study was the finding that there was often a long delay between third-year undergraduates learning a practical skill in a skills laboratory at Cardiff University, and carrying out the same items of treatment on a patient. For most students, this interval was between three and six months, but for some the time lag was almost one year. Not surprisingly, many junior students reported that they lost confidence, while staff expressed concern that many students were becoming deskilled through lack of appropriate practice.

Towards the end of 2012 a collaborative staff-student partnership was formed to tackle the problem of declining practical skills amongst undergraduates following periods of non-practice. A number of options were considered. An obvious solution would have

been to have increased the level of student- patient contact. However, this was considered impractical due to timetabling constraints, and because in the world of clinical dentistry, patients do not come 'neatly packaged'. Clinical teachers have traditionally tried to manage patient care so that students begin working on very simple items of treatment first before tackling more difficult procedures. However, a frequent mismatch between the educational needs and capabilities of the learners, and the clinical needs of patients means that even when there is no shortage, many patients are deemed unsuitable for treatment by junior students.

Another option was to allow students unsupervised access to the skills laboratories at times when they were not being used for teaching. This was rejected not solely because of health and safety reasons, but because the evidence in the literature demonstrates that the *quality* of practice is as important as the quantity (Ericsson 2008; Ericsson, Krampe & Tesch-Romer 1993). The importance of teachers to guide and support novices in their journey through the instructional process is now recognised to be fundamental to a successful outcome (Vygotsky 1978). If access was unsupervised, it was felt that there would be a danger that errors would become further embedded in the student's understanding and learning.

The challenge for the group was to present their evidence to those responsible for managing the curriculum at The School of Dentistry, and to persuade them that the students needed a more flexible approach to managing their own learning. A case needed to be made that it was not sufficient to provide unsupervised access to the skills laboratory. The learners needed an experienced teacher to guide the sessions and to provide support. In the current economic climate in higher education it was expected that the latter would prove to be a significant challenge. This paper details the evolution of the project from its inception to the present time. Whilst this work is focussed on dentistry, the findings could also have relevance and application to other healthcare settings.

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Literature review

To anchor the project and to increase the knowledge base underpinning it, a literature search was undertaken that focused on the factors believed to be important in the acquisition and retention of psychomotor or practical skills.

The theories that underpin the learning and teaching of practical skills have emerged from a number of diverse disciplines including education, psychology, sociology, philosophy and anthropology (Kneebone & Nestel 2011). Within these paradigms, behaviourism, cognitivism and constructivism have all been identified as having particular importance.

Deconstructing and constructing a skills performance

There are many theories accounting for the creation and growth of motor skills (Curzon 2004), but most are similar to the stimulus-response approach proposed by the American psychologist Robert Gagné (1985), where breaking the skill down into smaller components is seen as necessary. His theory suggests that motor skills are best taught in short sections that constitute the total performance in the sense that they occur simultaneously or in temporal order. Integrating the part skills already acquired is recognised as a highly significant aspect of the total learning. Fitts & Posner (1967) refer to this particular component as an 'executive subroutine'.

However, others believe this approach is too simplistic, and that the learning of simple tasks is different from the way complex tasks are mastered, so joining together a series of simple tasks to make a complex skill may be erroneous (van Merrienboer 1997). Studies have been carried out to investigate whether practising the part skills that make up the whole skill is more advantageous than practising the whole skill from the outset (Naylor & Briggs 1963), but no clear picture has emerged from this research.
The excellent reviews of Anders Ericsson and others have been pivotal to understanding skills acquisition, and importantly its maintenance in a variety of domains including music, sports, games and medicine (Ericsson, Krampe & Tesch-Romer 1993; Ericsson & Charness 1994; Ericsson 2004, Ericsson 2008). Much of what has been

written about healthcare pertains to medicine, but it is reasonable to assume the same principles could be extended to dentistry.

Ericsson (2004) has challenged the previously accepted wisdom (first introduced in the 19th century by Francis Galton) that the level of practical expertise that can be achieved is limited purely by innate biological differences. He presents an alternative perspective in which all that separates those whose performance has reached an international standard of excellence from their other less proficient colleagues is a minimum of ten thousand hours of deliberate practice. However, while this information is interesting, it provides no information about how long it takes for a novice to reach a level of competence compatible with the safe provision of patient treatment.

What does seem to be clear is that practice time alone has been shown to be insufficient for the development of good practical skills, a finding that is perhaps counter-intuitive. Crucially, practice should take place in a focused domain where the learner understands both the aim of a skill they are trying to master as well as perfecting its performance (Ericsson, Krampe & Tesch-Romer 1993; Ericsson 2004). Additionally, it is important that it is coupled with immediate and individualised feedback from a teacher (Lee, Swinnen & Serrien 1994), as this been shown to increase learning (Issenberg & McGaghie 2002) and improve long term skills retention (Liddell et al 2002).

Factors that influence skill decay and retention

The deterioration of acquired knowledge and skills that occurs following non-use for extended periods of time is well known. The longer the period of non-use after initial learning, the greater the decay (Arthur et al 1998). The difficulties are further compounded if the task has only been recently acquired or updated, as in novice hands it will be forgotten easily (Farmer et al 1999).

Overlearning or enhanced learning refers to the deliberate overtraining of a task beyond a set criterion or that required for initial performance (Driskell, Willis & Cooper 1992). Overlearning has been identified as the single most important determinant for both knowledge and skills retention (Farr 1987; Chambers 1987) and is an effective means of enhancing task performance (Schendel & Hagman 1982). The mechanism is

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believed to be associated with strengthening the bonds between stimulus and response, thereby decreasing the likelihood that the response will decay (Farr 1987; Schendel & Hagman 1982; Arthur et al 1998). Over-learning probably increases automaticity, reducing the concentrated effort demanded of the trainee. It is recommended therefore that all skills training has an element of enhanced learning built into it (Arthur et al 1998; Donovan & Radosevich 1999).

Kneebone and Nestel (2011) have suggested that those teaching in skills laboratories should be mindful of this concept, particularly in light of the recent shift towards competency-based programmes of study where the focus can end up being directed towards the demonstration of a minimum standard required for safe practice.

Supporting learners and scaffolding

The framework developed by the Russian psychologist Lev Vygotsky (1978) and other socio-cultural theorists, and applied to educational contexts (Wood, Bruner & Ross 1976) would also seem to have relevance here. Vygotsky (1978) introduced the concept of a "zone of proximal development" (ZPD). This represents an intermediate zone between what learners can do on their own, and what they cannot. It sets the context in which a learner can make progress with assistance from a more knowledgeable guide. However, the key to success lies with the learner and tutor developing good communications, mutual respect, and trust so that they can work together as a team (Kneebone & Nestel 2011).

Bruner (1986; 1990) introduced the concept of 'scaffolding' learning, which underlined not only the importance of teachers knowing when to step forwards to support learners but also *when* to gradually withdraw that support. This would seem to have particular relevance when learners are placed in the new and challenging environment of a clinic. Studies carried out in healthcare settings to determine the length of time it takes for knowledge and skills to begin to decline with non-use have produced variable results. Some researchers have found a sharp decline in both after a period of just 4-6 months (Watt 1987; Bulllock 2000), whilst others have reported a significant decrease after just ten weeks (Broomfield 1996).

A follow up study of 124 occupational first aiders that had received cardio-pulmonary resuscitation skills training revealed that only 12% were capable of carrying out effective resuscitation after a three-year period. The rate of skills decay was noted to be rapid, with fewer than 20% achieving a performance score of 75% after a period of 6 months post training (McKenna & Glendon 1985).

In the context of military training, procedural skills have been shown to fall back to operationally unacceptable levels after periods of months, or even weeks of non-utilisation (Arthur et al 1998; Farmer et al 1999). The meta-analysis that included 355 articles by Arthur et al in 1998 revealed that after a period of one year of non-use, performance levels for the average person would drop by 92% in comparison with their original score.

Implications for learning and teaching

The findings of Ericsson and others can be aligned to the experiential learning concepts of 'learning by doing' as theorised by Kolb (1984). He postulates that learning is a continuous process whereby knowledge is created through the transformation of experience. He proposes a cyclical four-stage model based on Lewin's work from the 1950s comprising concrete experience, reflective observation, abstract conceptualisation and active experimentation. Kolb's learning model and Ericsson's research indicates that people acquire expertise not just by the sheer act of doing; it is *how* they learn from that experience that impacts on the level of skill attained. Thus, it is the *quality* of practice that is as important as the quantity, an aspect perhaps not always appreciated by educators when designing courses (Curzon 2004).

Gagné's research (1985) suggests that though skills decline with time, vestiges of the original learning can be retrieved many years later, as the executive sub-routines often remain intact. This is why many people can remember the basics of how to play a musical instrument after many years of non-practice, though performance is likely to be uneven. Short refresher courses that can reactivate these lost skills would seem to be of benefit (Wisher et al 1991).

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Method

Gathering baseline information

As a starting point, information was gathered about the experiences not just of junior students in their third year of study, but across the entire four years of the clinical dental curriculum. A qualitative approach was taken in order to explore students' thoughts and feelings (Silverman 2011). Initially, this was achieved by face-to-face meetings at focus groups. Attendance and participation at these meetings was entirely voluntary. It was clear from these discussions that the decline in practical skills was not confined solely to the most junior years, but was endemic throughout the entire BDS curriculum.

Formation of the group

A decision was taken to form a staff-student collaborative partnership in an attempt to tackle the problem. The group consisted of students who had previously collaborated with the project lead and principal author of this paper on other education projects (including the original piece of research on which the current project was based) and who were interested in effecting educational change. At times, discussions widened to canvass the opinions of the entire student body. This was achieved by close liaison between the project lead and the student year representatives, and by using e-mail as a means of communication.

Developing a vision and a strategy for change

The students began by defining a vision that they intended to articulate as a proposal to those managing the curriculum. Basically, they wanted optional and fully staffed revision sessions to be made available in the skills laboratory that they could attend at times that were convenient to them. Essentially, this translated to mean any time, of any working day, with lunchtimes identified as their preferred option. Probably due to the increased cost of funding a degree, many students are now very conscious of getting value for money from their higher education institution. However, these initial expectations were seen as unreasonable by the project lead and other preclinical teachers, and presented

the first hurdle and the first source of tension within the group. If the staff-student partnership was to be successful in negotiating with the school management, it was obvious that some compromises would have to be made. Following further discussions, the students then drew up a detailed but more realistic 'wish-list'. This included the following:

- Low threat environment
- Supportive teaching
- No formal grading of performance
- Flexible access
- Small group teaching
- Student selected activities
- Greater control over their learning
- Activities directly linked to patient care

Of concern to the learners was that the revision sessions should function as a more 'relaxed' learning space than their routine time-tabled classes. They felt that the best way for them to (re) learn skills was to be in an environment where they were completely comfortable admitting that they did not know how to do something (even when they had previously learned the skill). In order to facilitate that, they wanted to have a voice about the suitability of any teacher appointed to guide the sessions. They accepted the idea of the usefulness of individualised feedback on performance. However, there were strong feelings that practical work should not be formally graded (as happens during routine classes) because of concerns that poor grades would end up being recorded in their personal files. Most students felt that being part of a large group had a negative effect on their ability to learn practical skills. Their ideal staff: student ratio was identified as 1:6 (compared with current timetabled classes where sometimes the ratio is closer to 1: 11). Furthermore, they wanted any additional teaching to be individualised to their needs and linked directly to patient care. Thus, if they had a patient attending for a particular procedure in the near future they wanted to be able to practise that particular skill, even if others in the group were working on different exercises.

Outcome

Barriers

The school's undergraduate programme director and other policy makers were approached at the end of 2012, and findings and conclusions of the staff-student collaborative group were presented. The initial reaction of the school was very negative. The three major barriers to moving the project forwards were that it would be cost-prohibitive, that students would not attend sessions if they were not compulsory, and that it was difficult to see how additional practical classes would fit within the current framework of assessment at the school.

Moving forwards

After a further period of lobbying, the school agreed to provide a single skills-laboratory 'drop-in' session on a Tuesday morning for a trial period of 3 months, and importantly, it would be guided by an experienced part-time teacher who also had a wealth of experience in general practice dentistry. Up to to 8 students from years 2-5 were permitted to book a place on a 'first come first served' basis. It was agreed that detailed verbal feedback on performance would be provided, but there would be no formal grading of work.

Four weeks later the sessions were oversubscribed, with many students reporting that they were unable to access the new resource due to timetable constraints i.e. they were either in lectures or treating patients when the sessions were running. Further negotiations with senior management over the next eleven months resulted in a gradual increase in the sessions from one to three, with an indefinite extension of provision. Throughout the whole of this time the students continued to lobby for a session on a Wednesday afternoon in order to widen access to all clinical students (Wednesday afternoon is a time when students receive no didactic teaching), but the school remained intransigent to this request.

In October 2013 further discussion took place amongst the group, specifically about the provision of a Wednesday afternoon session. The opinion of the entire student body was sought via e-mail. One hundred and twenty positive responses were received within a one hour timeframe. There was a single negative response with sporting commitments cited as the reason.

In January 2014, the school finally agreed to Wednesday afternoon sessions. These were soon fully subscribed, with all other available sessions either fully, or two-thirds fully subscribed. Between January 2013 and March 2014, a total of 157 students attended at least one 'drop-in' session in the skills laboratory, which represents 42% of the total intake of clinical students enrolled on the BDS course. Many students attended more than once, with 5 being the maximum number of times anyone attended.

Student feedback

Every time a student attended a session they completed an anonymous questionnaire to gather additional data and for quality assurance purposes. Questions included the reasons for attendance and the time interval between first learning the skill and refreshing or relearning it. A simple ten-point numerical scale was used to measure how confidence levels had changed from the start to the end of the session. Learners were also invited to comment on how the sessions could be improved.

Almost all students reported that they attended with the aim of refreshing specific practical skills. Many came to practise specific items of treatment they needed to provide for patients in the near future. Every undergraduate who attended the sessions reported that their confidence levels had increased. On a scale of 1-10, the greatest increase recorded was 8 points. The longest period recorded between first learning a skill and carrying out the same task on a patient was found to be a period of 2 years. With regards to improving the sessions, the only comments made by the students were that they would like even more sessions to be provided.

Illustrative pull-out quotes from the student feedback:

These sessions are invaluable! This is the only way I feel I will be able to improve – we just haven't had enough practice in a skills lab close enough to the time of doing it on a patient.

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> *feel so much more confident. I feel I have been given tips that are tailor-made for me, and for
> what I want to learn.*

> *It is really useful to have somebody who can give you one-to-one help when you need it, and to
> focus on what you are doing wrong. This doesn't work as well in the phantom head courses
> because the groups are just too big, and the staff are too busy.*

> *It was great, I could ask as many questions as I liked and practise what I wanted.*

Many students subsequently contacted the project lead by e-mail to share their
experiences of how attending the 'drop-in' sessions had resulted in a more positive
experience in a clinical setting. The following are illustrative quotes:

> *I will definitely be wanting to use these sessions again. I can't say enough about how helpful
> they've been. I can learn what I want, when I want. I was cutting a crown preparation on the clinic
> the other day and the supervisor said he couldn't have done much better himself. This is all down
> to me coming to the extra sessions.*

> *My tutor on the clinic remarked that I had performed so much better than when he last supervised
> me. He asked me how this had happened and I said it's because I have been to the 'drop-in'
> sessions.*

Discussion

Not surprisingly, the difficulties reported by staff and students at Cardiff resonated with
the reports in the literature of significant decline in skills over time following periods of
non-use, particularly when those skills had only been just learned and had never been
used.

Assuming any health and safety concerns could have been overcome, a quick-fix
solution would have been to have allowed the students to work unsupervised in the
skills laboratories when they were not being used for teaching purposes. It is possible
that this might have produced a satisfactory outcome. However, it was felt that the key
to producing the *best* outcome lay in the education literature. Having a better
understanding of the theory that underpins the acquisition of practical skills and the

factors that impact on performance over time was seen as crucial to providing a platform from which to launch the project. The group were able to make explicit use of current best practice to influence the decision makers that an expert teacher was essential to guide the sessions and to provide appropriate 'scaffolding'. Even though the literature is vague about the optimum time that should be devoted to 'overlearning' (Driskell, Willis & Cooper 1992), once the benefits were appreciated it seemed sensible to incorporate that pedagogical approach routinely into all practical sessions.

A conscious decision was taken not to 'stream' attendees according to year of study, but to open every session to anyone who wanted to book a place regardless of seniority. This decision enabled students to make the best use of the time available. However, the benefits extended beyond simple time management. The approach, which is fundamentally different from what happens in routine didactic sessions, opened the doorway to exploring the possibility of students at different stages of their education learning together in one classroom. This is not a new concept, and already happens in clinical settings, with junior students assisting more senior colleagues at chair-side via 'buddying' schemes. However, in this context it had the potential to be taken a stage further by adopting an entirely new pedagogical approach to learning within the school. Any initial concerns as to how it might actually work in practice were quickly dispelled. Indeed, it soon became clear that there were significant benefits. Junior students reported that they appreciated being able to work alongside more senior colleagues, and were able to learn from their peers as well as from the clinical supervisor. Senior undergraduates reported that they enjoyed helping more junior colleagues, and were able to provide them with an insight into the skills they would be learning later in the course.

Because all of the practical exercises being (re) learned in the sessions had already been taught previously, it proved to be a less onerous task for the tutor than if he had needed to start from scratch, presumably because of persistence of the executive sub-routines. The staff: student ratio of 1:8 was higher than the students' perceived ideal, but was felt to be manageable by the clinical tutor. Whist there was an improvement in the skills that students were able to perform in a skills laboratory on a manikin, what is perhaps more important is that this learning can be translated into a clinical context and be shown to benefit patients directly. The illustrative comments of the students quoted

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here represent just a fraction of those collected that would seem to demonstrate this important effect.

Not surprisingly, funding was a major stumbling block. The school was extremely generous in agreeing to additional funds to purchase materials used in the skills laboratory, but securing funds to pay for a member of staff to guide the sessions was a much greater challenge. After a period of negotiation, agreement was reached to fund a single session for a trial period of three months. This was achieved by reducing cover in other areas where the impact on teaching would be minimal and could be absorbed. Any concerns the policymakers had that students would not attend additional classes on an entirely voluntary basis were completely unfounded. The initial Tuesday morning session was fully booked within weeks. The school responded positively by increasing the number of sessions from one to three over a nine month period. However, there was intransigence over the Wednesday afternoon session, simply because there was no didactic teaching on Wednesdays and no money was available to fund it. A solution was found by 'thinking outside the box'. Thus, an arrangement was agreed whereby the clinical tutor would work on a Wednesday and then 'claw-back' the time during periods when the students were away from the school on vacation, and when staff would otherwise be in engaged in administrative duties. This flexible arrangement suited all parties.

Whilst student feedback is already collected formally at regular intervals throughout the curriculum for quality assurance purposes, it could be argued that the learners have relatively little power, as the teachers have a monopoly on all decision making. Through the staff-student partnership, they were able to become actively engaged in a higher level of discussion and have some control over their learning in terms of planning, delivery and delivery

The project can be seen as innovative for the following reasons:

- It brought together junior and senior undergraduates in an entirely new context to work as a team towards a common goal.

- It has challenged the accepted wisdom that the only way teach practical skills was to anchor the learning at fixed points within the curriculum.
- It has dispelled the myth that students would not engage with learning that was not a compulsory component of their training.

There is no doubt that the person chosen to guide the practical sessions was pivotal to their success. Previous research at Cardiff that sought dental student opinion on the desirable characteristics of clinical teachers identified 'approachable personality' as important. Furthermore, the impact of the power position of the tutor in providing feedback should not be underestimated as "even the smallest word or shortest sentence can make a difference" to student learning (Fugill 2005 p133).

The local success of the project is evidenced by the high level of student uptake of the optional 'drop-in' sessions, increased student confidence and demonstration of transfer of learning from laboratory to a clinical setting. However, impact was also achieved in the wider context at institutional level in terms of changing the philosophy of how practical skills should be taught in dentistry. The challenge for the future is to build on the forward momentum of the project by exploring the possibility of using senior students as near-peer tutors to mentor junior colleagues.

Conclusion

Towards the end of 2012 a collaborative staff-student partnership was formed at the school of dentistry, Cardiff University to tackle a problem identified by both staff and students. An important outcome of this collaboration is that there is perhaps a better understanding of how the teachers and learners perceive each other. The optional 'drop-in' sessions that were arranged to correct the problem have continued to run beyond the life of the original project, and many more students have benefited since March 2014 from them. With careful planning and creative thinking, here is every reason to assume that this success could be replicated elsewhere in the higher education sector.

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Acknowledgement

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