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Evaluation of educational approaches to undergraduate teaching: their effect on life-long learning attitudes and clinical competence

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Summary

National policies on third level education within Europe are being driven by the agenda of the Bologna process and its objective to create a European Higher Education Area (EHEA) by 2010. There is a shift from the traditional "teacher-centred" approach to a "student centred" approach which focuses on what the students are expected to do at the end of a modular program. In an attempt to find an alternative educational philosophy, which would improve the outcome of higher education, Problem Based Learning (PBL) was introduced.

Problem based learning (PBL) arguably represents the most significant development in education over the past five decades. It has been widely adopted by many medical and dental schools including Dublin Dental School and Hospital (DDSH). The intention was to classify and interpret the available evidence, extract relevant conclusions and propose recommendations regarding the relative benefits of PBL compared with conventional teaching. The literature was searched using PubMed, ERIC and PsycLIT and the reference lists of selected papers. Articles were chosen and included according to specific selection criteria. Studies were further classified as randomised controlled trials (RCTs) or comparative studies. These studies were then analysed according to intervention type. At the level of RCTs and comparative studies (whole curricula), no clear difference was observed between PBL and conventional teaching. It was only comparative studies of single PBL intervention in a traditional curriculum that yielded results that were consistently in favour of PBL.

It is generally believed that PBL, due to its structure, enables the students to be better prepared for self directed life-long learning than graduates of conventional curricula. In the second part of this thesis, the significance of the undergraduate dental curriculum on the medium to long-term attitudes of the clinician to life-long learning was investigated. Furthermore, demographic and professional characteristics which may influence this attitude were identified. This was achieved by designing a questionnaire that targeted 12 cohorts of dentists who qualified from the

DDSH between 1994 and 2005. The curricula of the cohorts varied from fully didactic, exclusively PBL or a hybrid for the oldest, youngest and middle graduates respectively. Participants were questioned about current professional activities, postgraduate training, practice type, hospital affiliation, use of information services and time dedicated to continuing dental education (CDE) etc. A number of dental scenarios were proposed to determine if participants were adherent to current clinical guidelines. Additionally, a Visual Analogue Scale (VAS) assessed the overall satisfaction of dentists with their undergraduate programme and determined their opinion regarding its influence on their subsequent ability to practice dentistry and keep up-to-date with scientific developments. Contingency analysis of the association between curriculum and continuous education data did not produce statistical significance. Dentists that work in a hospital environment spend more time on Continuing Dental Education (CDE) (χ^2, Pearson's, p=0.001), are more adherent to current guidelines (χ^2, Pearson's, p=0.005) and found their undergraduate studies more enjoyable (Wilkoxon / Kruskal-Wallis, p=0.01). Conclusively, undergraduate curriculum type was found to have very little or no effect on the graduate's attitude toward life-long learning or confidence in their ability to practice dentistry. However, these attitudes did appear to be influenced by certain family, demographic and professional characteristics. Following on from the questionnaire, a cohort of 12 dentists were interviewed in order to tease out further information regarding their responses. This interview approach confirmed the majority of the results from the initial questionnaire.

At present, the Dublin Dental School and Hospital (DDSH) is only using the secondary school grade point average in order to select its students. However, there is a belief that if students are not selected with reference to the full range of learning outcomes, there is a possibility that some of them may still have major deficiencies in their professional abilities at graduation. Since dentistry requires very specific clinical learning outcomes, innate aptitude may be important as it may affect one's ability to follow the required training. In the third part of this thesis, the aim was to gain an insight into how this selection process impacts on the students'

clinical progress. A group of 2nd year dental students with no previous experience in operative dentistry were asked to prepare a conventional class I cavity on a lower first molar typodont. Their first preparation was carried out after an introductory lecture and a demonstration and their second at the end of conventional training. The prepared typodonts were coded and blindly scored according to traditional assessment criteria of outline form, retention form, smoothness, cavity depth and cavity margin angulation. Once the codes were broken, a paired t-test was used to compare the difference between the means of before and after scores ($p < 0.0001$) and a Pearson's linear correlation tested the association ($r = 0.4$). From the results obtained, it was concluded that conventional preclinical training results in a significant improvement in the manual skills of the dental students. The dental procedure used had only a limited predictive value for later performance at the preclinical level. Additionally, students who scored low initially markedly improved by the end of training but those that scored high initially improved little or not at all.

In a well structured curriculum, students should be able to see how learning opportunities like a restorative class relate to the course outcomes. The last part of this study evaluated components of the educational approaches that have been adopted by the DDSH for clinical teaching of undergraduate students. It was investigated if there was an agreement between the students and supervisors on the quality of clinical teaching in restorative dentistry in the DDSH and an attempt to identify differences on how effective clinical teaching was perceived between the three academic years. In addition, an effort was made to identify the existence of any similarities between students and supervisors perceptions of specific teaching behaviours that are most and least helpful in learning. A questionnaire based on the above objectives was distributed to 3 cohorts of undergraduate students and 3 cohorts of clinical supervisors. The response rate was 94%, 94% and 63% for the 3rd, 4th and 5th year students respectively. Twenty one out of the 36 supervisors returned the questionnaire. Basic analysis identified the distribution of the variables between the groups. These distributions were compared using a Kruskal–Wallis test. The degree of association was

measured by the Pearson's χ^2 values. Students from different years reported different requirements of teachers whereas the teachers perceived the needs of different years as similar. The more senior students (in contrast to their more junior colleagues) felt that questions posed by their clinical supervisors were not necessarily conducive in promoting learning (p= 0.007) and commented that their clinical learning was not sufficiently evidence based. While the students felt that the enthusiasm of teachers was important the supervisors did not. Overall, there was a limited agreement between students and supervisors on the effectiveness of clinical teaching and the way effectiveness was perceived between students and clinical supervisors as well as between senior and more junior students. Finally, the results of this study were relayed to the supervisors and from their feedback we reached the conclusion that there is not enough attention being paid to critical components like 'rigid guidelines', 'proper staff training' and 'formal feedback structures' that underlie the delivery of our dental curriculum.

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1 Introduction

The current scale of economic and social change combined with the rapid transition to a knowledge-based society has and continues to create challenges which demand a new approach to education and training by education systems across Europe and beyond (Gravani 2003, Plasschaert *et al.* 2007). Increasingly, national policies on third level education within Europe are being driven by the agenda of the Bologna Process and its objective to create a European Higher Education Area (EHEA) by 2010. This process, begun in 1998, evolved into what is more or less its present form in 1999 (Kennedy *et al.* 2007).

The traditional way of designing modules and programmes was to start from the content of the course. Teachers decided on the content that they intended to teach in the programme, planned how to teach this content and then assessed the content. This type of approach focussed on the teacher's input and on the assessment in terms of how well the students absorbed the material. Course descriptions referred mainly to the content of the course that would be covered in lectures. This approach to teaching is commonly referred to as a "teacher-centered" approach (Gosling & Moon 2001, Kennedy *et al.* 2007).

International trends in education show a shift from the traditional "teacher-centered" approach to a "student-centered" approach. This alternative model focuses on what the students are expected to do at the end of the modular programme. Hence this approach is commonly referred to as an "outcome-based" approach. Statements called "learning outcomes" are used to express what it is expected that the students will be able to do at the end of the learning period (Kennedy *et al.* 2007). Clark *et al.* (2004) describes learning outcomes as the basis of the educational programme and not an end in themselves. "In an outcome based approach, decisions about student selection, curriculum planning, teaching, learning and assessment should be driven by the agreed learning outcomes".

As a profession, Dentistry calls for a broad spectrum of knowledge relating to both oral and basic sciences as well as specific clinical skills. As a result, various learning and teaching methods are required in order to ensure that the dental students become competent prior to graduation. According to the views of the Association for Dental Education in Europe (ADEE) laid down in an article published in the European Journal of Dental Education (EJDE), "teaching should be student-centred and flexible, supporting a variety of learning styles". Additionally, in this same article, the authors stressed the importance of the undergraduate courses having their aims, learning outcomes and assessment methods clearly stated as well as being assured of quality and updated regularly (Plasschaert *et al.* 2007).

According to Plasschaert *et al.* (2007), traditional, lecture-based teaching, due to its excessive emphasis on memorisation, does not help students construct new knowledge on the basis of current knowledge and as a result, it might not be able to facilitate the achievement of the learning outcomes. In an attempt to find an alternative educational philosophy, which would improve the outcome of higher education, Problem Based Learning (PBL) was introduced. Furthermore, PBL was designed to encourage characteristics like critical thinking, self directed learning and problem solving (Plasschaert *et al.* 2007). Additionally, PBL is also believed to reinforce the vertical integration of basic sciences and clinical areas as well as the horizontal integration across basic science subjects (Manogue and Brown 2007, GDC 2002). In the first part of this study, existing literature will be reviewed on the effectiveness of PBL as opposed to didactic teaching in undergraduate dental students. Additionally, an effort will be made to identify the advantages and disadvantages of each instructional approach and investigate their available evidence base.

It is generally believed that PBL, due to its structure, enables the students to be better prepared for self directed life-long learning (which is one of the main learning outcomes) than graduates of conventional

curricula. In the second part of this study, the aim is to investigate if the undergraduate curriculum instructional approach (PBL, hybrid or didactic conventional teaching) is a significant factor in determining the medium to long term attitude of the practicing dentist towards life-long learning. Additionally, there will be an attempt to identify other factors which could influence this attitude.

At the Malmö congress in 1994, the Association for Dental Education in Europe (ADEE) described the skills a student should have by the end of their course of study as intellectual, analytical, creative with manual aptitude positioning in space, ethical skills, good communication skills and psychological stability. So, are we selecting the right candidates for this job? Does the type of curriculum and its effect on lifelong learning matter if a student is uninterested in the course or is unmotivated due to poor performance during training? Can a student remain motivated when he is struggling to keep up with his classmates throughout the academic years? How important is a students' innate aptitude? At present, the Dublin Dental School and Hospital (DDSH), like most European dental schools, is using the intellectual capacity or academic ability of the applicants in the form of secondary school grade point average in order to select its students. However, there is a belief that there are other components/aspects such as practical communication and interpersonal skills which should also be considered (Clarke *et al.* 2004). "If students are selected without reference to the full range of learning outcomes, there is a good chance that some of them may still have major deficiencies in their abilities by the end of their training" (Clarke *et al.* 2004). Dentistry is considered unique in that it requires very specific clinical learning outcomes under the overall umbrella term clinical competency. If, as mentioned above, learning outcomes and clinical competency should influence the selection and training of a dentist, innate aptitude may be important as it may affect one's ability to follow the required training.

In the third part of this study and before evaluating the clinical teaching in Restorative Dentistry, the aim is to gain an insight into how the

current DDSH selection process impacts on the students' clinical progress. In order to achieve this, an effort will be made to determine if completion of a dental procedure at the outset of learning can predict later performance at the preclinical level and observe if conventional training significantly improves pre-clinical performance.

According to Clarke *et al.* (2004), by mapping learning opportunities to outcomes, the students can select the appropriate learning methods to achieve them. Additionally, in a well structured and run curriculum, students should be able to see how learning opportunities like a restorative class relate to the course outcomes. In order to facilitate this process, clinical teachers should have an overview of the curriculum and a good understanding of their contribution to the students learning (Oliver *et al.* 2008). They should also be able to understand that students have different approaches to learning and a variety of learning styles. Furthermore, formative and summative assessment provides the students (and teachers) with feedback on the effectiveness of their learning (and their teaching) in terms of whether or not there is progression in the achievement of the learning outcomes (Clarke *et al.* 2004). The fourth and last part of this study will explore any agreement between the students and supervisors about the quality of clinical teaching in Restorative Dentistry in the DDSH and will try to identify any differences between three academic years. Additionally, this section of the study will attempt to identify any similarities between students' and supervisors' perceptions of specific teaching behaviours that were deemed most and least helpful in learning.

The dental undergraduate curriculum at the DDSH has evolved in response to these changing needs. The new curriculum, introduced in 1998 adopted PBL and approaches to teaching and learning that encourage the students to take more responsibility for their own learning and an approach to assessment which emphasizes the overall objectives of the course. This research aimed to evaluate components of some of the educational approaches adopted for teaching of

undergraduate dental students and their effect on key learning outcomes such as life-long learning attitudes and clinical competence.

Since none of what has previously been discussed would be possible without flawless development of the human brain, and because there are major differences in the way incoming information is stored and processed in different people, a brief overview of the development of the human brain and a description of the most popular learning theories follows.

2 Literature review

2.1 The human brain

Messages travel through the human nervous system by both electrical transmissions that run through individual neurons and chemical transmissions that traverse synapses between neurons. Synapses in the spinal cord are responsible for a few basic reflexes, but by and large the brain is the coordination and decision-making centre for the body. Through research, scientists have learned a great deal about how our brain works. In the human brain, the forebrain, which is the largest and most recently evolved part, predominates in consciousness, thinking and learning. Even small, seemingly simple tasks though, typically involve many parts of the brain working together in harmony (Goldman-Rakic 1992, Goodman & Tessier-Lavigne 1997).

The initial development of the brain begins late in the first month of prenatal life; by the second trimester, the great majority of neurons a person will ever possess have formed and are migrating to their final locations. Synapses among neurons begin to form before birth. Shortly after birth, the rate of synapse formation increases dramatically, to the point where children have many more synapses than adults do. Over the course of childhood and adolescence, the brain cuts back little used synapses, apparently as a means of adapting to its environment and increasing its efficiency. Although most brain development occurs during the prenatal period and early childhood years, some changes in brain structure and neurotransmitters continue into adolescence and adulthood (Carlson 1999, Bressler 2002).

2.1.1 Critical periods in brain development and factors that influence this development

It has been proven that heredity plays a significant role in brain development. For the most part, heredity ensures that processes as cell

migration, synaptogenesis and myelination form correctly as the brain continues to grow and restructure itself. Occasionally however, flawed instructions can cause things to go wrong (Byrnes 2001).

Environmental factors also have effects on brain development as well. One important factor is malnutrition. Severe malnutrition is most problematic during prenatal development when it results in reduced production of neurons and glial cells (Byrnes 2001). After birth, malnutrition hampers cell growth, myelination and performance on psychological measures of cognitive development like intelligence tests. The effects of short term impoverishment can often be reversed by better diets later on (Whaley *et al.* 1998, Byrnes 2001). Environmental toxins, too, have an impact. When women consume significant amounts of alcohol during pregnancy, their children may develop fetal alcohol syndrome, a condition characterised by distinctive facial features, poor motor co-ordination, delayed language and mental deficit. Ingestion of excessive amounts of lead, mercury, cadmium or pesticides can result in deficits in learning and cognitive abilities. Exposure to radiation during the period of rapid neuron production in the first few months of prenatal development leads to mental retardation but has little effect at later points in development (Goldman-Rakic 1986).

Opportunities to learn also influence brain growth. People who have learned to read and write have, in their corpus callosum, a thicker band of fibers connecting their parietal lobes (Castro-Caldas *et al.* 1999). People who learn to play a musical instrument show detectably different organizational patterns in the brain than nonmusicians (Elbert *et al.* 1995) Intensive interventions for congenital or acquired disabilities like blindness or dyslexia, lead to reorganizations of brain structure or changes in patterns of brain activation (Nicholls 1982).

Although the human brain is fairly adaptable to changing circumstances, it can't always bounce back when the environment offers too little stimulation or consistently presents the wrong kind of stimulation. In some cases, the timing of environmental stimulation (or

lack thereof) makes a considerable difference. It seems that there are sensitive periods in certain aspects of brain development in which certain forms of environmental stimulation have their greatest, and perhaps only, impact. Musicians who began their musical training before the age of ten, show greater activation in certain part of their brains than those who began their training at an older age (Elbert *et al.* 1995). They don't necessarily play better than the others, but according to Elbert *et al.* (1995), the later- trained musicians "appear to have missed a window of opportunity" for fully developing the brain area that the earlier-trained musicians are using.

In humans, there may be critical periods in learning language. Children, who have little or no exposure to language early in their life often have difficulties acquiring language later on, even with intensive language instruction (Curtiss 1977, Newport 1990). Furthermore, it has been observed that in the first few weeks of life, infants can discriminate between speech sounds used in a wide variety of languages, but by the time they are six months old they hear only those differences important in the language spoken around them (Kuhl *et al.* 1992, Kuhl *et al.* 2003). Additional evidence for critical periods in language development comes from people who learn a second language. Typically people learn to pronounce a second language flawlessly only if they study it in the preschool or early elementary years (Collier 1989, Bialystok 1990).

Some experts do not believe that there are critical periods for all skills and knowledge domains. Often, people can become proficient in topics or skills that they do not begin to tackle until they are teenagers or adults (Ormrod 1999). It appears that critical periods exist for certain basic abilities such as visual perception and language but even in these domains, the "windows of opportunity" remain open for different periods of time as well as for different aspects of those abilities. They seem to close gradually over a prolonged period and in some cases stay marginally open for a very long time, particularly if the right kinds of experiences are provided. For complex, culture specific acquisitions including most of the topics and skills that we teach in schools and

universities, learning seems to be possible throughout childhood and much of adulthood (Greenough *et al.* 1987).

2.2 Learning theories

In psychology and education, a learning theory describes how people and animals learn and also explains human responses through the concept of learning.

Learning theories include behaviourism, cognitivism, and constructivism. Behaviourism focuses only on the objectively observable aspects of learning and explains human reaction in terms of learned behavior. Cognitive theories look beyond behaviour to explain brain-based learning. Constructivism views learning as an active attempt to construct or build new ideas or concepts.

2.2.1 Behaviourism

Behaviourism, as a learning theory, can be traced back to Aristotle, whose essay "Memory" focused on associations being made between events such as lightning and thunder. It assumes that a learner is essentially passive, responding to environmental stimuli. The learner starts off as a clean slate (i.e. tabula rasa) and behaviour is shaped through positive or negative reinforcement. Learning is therefore defined as a change in behaviour of the learner. Much of the early behaviourist work was done with animals (e.g. Pavlov's dogs) and generalized to humans (Atkinson *et al.* 1993, Leonard 2002).

Experiments by behaviourists like Pavlov (1849-1936) and Skinner (1904-1990), identify conditioning as a universal learning process. There are two different types of conditioning, each yielding a different behavioural pattern:

1. Classical conditioning occurs through directly experiencing events. It simply operates by a process of association of one stimulus with another. Classical conditioning is universally known by association

with the Russian neurophysiologist Ivan Pavlov (Pavlovian conditioning). In Pavlov's basic experiment a dog is placed in front of the pan, in which meat powder can be delivered automatically. A light is turned on and after a few seconds some meat powder is delivered and the light is turned off. During this procedure, salivation is recorded. The salivation is the unconditioned response or (UCR) and the meat powder is an unconditioned stimulus or (UCS). This procedure is repeated a number of times and then, if the dog salivates when the light is presented alone it has learned to associate the light with food. This salivation is a conditioned response (CR), while the light is a conditioned stimulus (CS). Repeated pairings of the CS with the UCS reinforce the association between them. Pavlov also realised that a CS gradually loses its ability to elicit a CR if it is no longer paired with the UCS. This is known as extinction. Furthermore, once a CS is established, similar stimuli also elicit a CR. This phenomenon is called generalisation. Finally discrimination occurs if only one of these similar stimuli is paired with the UCS and then only it elicits the CR (Atkinson *et al.* 1993).

2. In operant conditioning, an animal or a person operates on an environment and produces a change, a consequence for the behaviour. Consequently, the organism is viewed as active. B.F Skinner was responsible for a number of experiments (Skinner box experiments) that helped researchers understand and study conditioning. A food deprived rat in a (Skinner) box presses a lever which results in food delivery. As a result, the rat learns that food is dependent on the occurrence of the lever press and this affects the likelihood of the response occurring again. Behavioural or operant conditioning occurs when a response to a stimulus is reinforced:

    - Positive reinforcement or reward: Responses that are rewarded are likely to be repeated. (Good grades reinforce diligent study).
    - Negative reinforcement: Responses that allow escape from painful or undesirable situations are likely to be repeated. (Being excused from writing a final because of good term work).

- Extinction or Non-Reinforcement: Responses that are not reinforced are not likely to be repeated. (Ignoring student misbehaviour should extinguish that behaviour).
- Punishment: Responses that bring painful or undesirable consequences will be suppressed, but may reappear if reinforcement contingencies change. (Penalizing late students by withdrawing privileges should stop their lateness) (Good & Brophy 1990).

There have been some criticisms of behaviourism, including the following: (Phillips & Soltis 2004).

1. It does not account for all kinds of learning since it disregards the activities of the mind.
2. It does not explain some learning; such as the recognition of new language patterns by young children, for which there is no reinforcement mechanism.
3. Research has shown that animals adapt their reinforced patterns to new information. For instance, a rat can shift its behaviour to respond to changes in the layout of a maze it had previously mastered through reinforcements

Educational approaches such as, curriculum based measurement, and direct instructions have all emerged from this model.

2.2.2 Cognitivism

Cognitivism focuses on the inner mental activities – opening the "black box" of the human mind is necessary for understanding how people learn. Psychologists who have a cognitive orientation work on a great variety of different phenomena. Their common element is that the behaviour under investigation depends upon events that are not actually operative at the time the behaviour occurs. If some behaviour is controlled by stimulus events that happened some time before, rather than by stimuli which are present immediately before the response occurs, that suggests the operation of a cognitive process (Bolles 1979).

In response to behaviourism, people are not "programmed animals" that merely respond to environmental stimuli; people are rational beings that require active participation in order to learn, and whose actions are a consequence of thinking. Changes in behaviour are observed, but only as an indication of what is occurring in the learner's head. (Leonard 2002). Since learned behaviour depends upon prior learning trials as much as upon contemporaneous events, learning itself appears to be a cognitive process (Bolles 1979). Cognitivism is currently the predominant perspective within which human learning is described and explained. It has affected educational theory by emphasizing the role of the teacher in terms of the instructor's effectiveness of presentation of instructional material in a manner that facilitates students' learning (e.g., helping students to review and connect previous learning on a topic before moving to new ideas about that topic, helping students understand the material by organizing it effectively, understanding differences in students' learning styles, etc.) Aspects of cognitivism can be found in learning how to learn, social role acquisition, and memory as related to age (Ormrod 1999).

It is important to note that although cognitivism is currently popular in education, Tolman E.C (1886-1959) was the only one of the major learning theorists to regard learning as cognitive. For him, what happens in a learning experiment is definitely cognitive and his interpretation of learning was entirely consistent with the view that cognitive processes enable an animal to behave in ways that are not completely dependent upon prevailing stimuli. Most of the other major learning theorists or 'Stimulus–Response' (S-R) theorists regarded learning quite differently. While they also describe behaviour as intelligent or adaptive, all cognitive processes are reduced to a single explanatory mechanism, the S-R association. According to them, whatever the behaviour and no matter how intelligent it may appear to be, it depends upon no more than some learned S-R associations. The behaviour seems to be totally controlled by the stimuli that are present at the time behaviour occurs (Bolles 1979).

More recently, the cognitive perspective was criticized for not being able to explain how identity is constructed and how social interactions influence the individual members of a community. Additionally, it also fails to explain how an individual learns completely new knowledge about which no prior knowledge exists. If learning occurs through the reconstruction of prior knowledge, how is completely new knowledge generated? Finally, it does not explain why some individuals can perform complicated mental functioning in an authentic setting (Schöenfeld 1999, Hoban 2002).

2.2.3 Social learning or social cognitive theory

Social cognitive theory accepts the role of conditioning and reinforcement as processes supporting learning. Despite this, it soundly rejects the notion that individual behaviour is a function solely of environmental inputs. The first theorist and researcher in the area of social learning was Albert Bandura. The major principle of Bandura's theory is triadic reciprocal determinism which refers to the mutually causal relationship among behaviour, personal factors and environmental events:

- Personal factors-beliefs, expectations, attitudes, knowledge, intelligence, motivation
- Physical and social environment- resources, consequences of actions, choices, other people, physical settings
- Behaviour- individual actions, choices, verbal statements

In one of his books, Bandura uses the famous composer Bach as an example and notes that "reinforcement cannot select what does not exist in a repertoire". Social cognitive theory suggests that Bach must have learned how to compose music through a combination of prior experience and generative intellectual creativity that is not reducible to biological or experimental influences (Bandura 1997).

The major difference between Bandura's social cognitive theory of learning and earlier theories is his definition of learning. He noted that people acquire internal codes of behaviour that they may or may not act

upon later. Therefore, he regarded learning and performance as two separate events (Bandura 1986)

2.2.3.1 Modelling

In another of his books, Bandura stated that "Of the many cues that influence behaviour at any point in time, none is more common than the actions of others" (Bandura 1986). This so called modelled behaviour serves to convey information to the observer in one of three different ways: (Bandura & Walters 1963).

(1) By transmission of precisely imitative response patterns not previously present in the observers repertoire.

(2) By acting to strengthen or weaken the existing restrains of the learner against performances of particular behaviour.

(3) To transmit new patterns of behaviour that are neither entirely novel or inhibited as a result of prior learning.

2.2.4 Constructivism

As a reaction to didactic approaches such as behaviourism and programmed instruction, constructivism states that learning is an active, contextualized process of constructing knowledge rather than acquiring it. Constructivists are primarily interested in how individuals build knowledge. Their ideas are mainly rooted in Piaget's psychological constructivist perspective which focuses not on "correct" representations but rather on the learner's contribution to meaning as constructed through individual and social activity. Knowledge is constructed based on personal experiences and hypotheses of the environment. Learners continuously test these hypotheses through social negotiation. Each person has a different interpretation and construction of knowledge process. Constructivist theories emphasize not only that learners' find the right answer but also the process of finding this answer (Leonard 2002). One of the major goals of instruction from the constructivist perspective is to provide students with experiences that produce cognitive conflicts. Teachers act as facilitators who encourage students to discover principles for themselves and to construct knowledge by working to solve realistic problems.

Additionally, they should be able to understand individual students' stages of cognitive development and set up developmentally appropriate tasks (Driscoll 2004). Constructivists advocate less teacher centred approaches to classroom instruction.

Constructivism itself has many variations, such active learning, discovery learning and knowledge building. Regardless of the variety, constructivism promotes a student's free exploration within a given framework or structure. Aspects of constructivism can be found in self-directed learning, transformational learning, situated cognition, and reflective practice (Ormrod 1999).

2.3 Learning in academic education

2.3.1 Traditional learning / education

When we discuss about traditional learning we usually mean the teacher controlled learning activity such as lectures (van Berkel & Schmidt 2005). It is the most common approach to education today and some believe that it presents to students new knowledge in a straightforward, convenient and economical way. Students only have to go to a lecture hall and they will be supplied with knowledge over a short period of time. Lecturing though does not particularly advance problem-solving skills, nor does it require creative or critical thinking or prepare students for the types of problems they will face as professionals. It had been the most popular way of teaching in schools and Universities until the introduction of Problem Based Learning. Nowadays there is a belief that lectures (only as part of a problem based curriculum) may be an important means to help students put their knowledge into a broader, often professionally relevant perspective (van Berkel & Schmidt 2005).

2.3.2 Problem Based Learning

Cognitivism and constructivism provide the theoretical foundations for understanding PBL. It is a philosophy of education which encourages students to develop critical thinking skills, apply their knowledge to real world problems and also helps them develop self directed learning skills. It derives from the theory that learning is a process in which the learner actively constructs new knowledge on the basis of current knowledge. It was originally developed in McMaster University in Canada during the 1960's, by a group of medical educators that became disenchanted with traditional health science education and its excessive emphasis on memorisation and fragmentation. Stimulated by the McMaster approach, other newly created medical schools (Maastricht in the Netherlands and Newcastle in Australia) developed a PBL curriculum in the early 1970's. This was followed in the 1980's by some existing medical schools who began converting their entire curriculum to PBL (spearheaded by the University of Hawaii, the University of Harvard, and the University of Sherbrooke in Canada). Subsequently, PBL has been adopted by medical schools around the world. In the 1990's it was adopted in a variety of professional schools (nursing, law, business, engineering, and psychology), college level courses in the sciences and humanities, as well as primary and secondary schools.

Characteristics of PBL are:

- Learning is driven by challenging, open-ended problems.
- Students work in small cooperative learning groups.
- Teachers provide materials and guidance that facilitate learning.

PBL sees learning as something that results from the learner's actions and the role of the PBL tutor is to enable and encourage learners to construct their knowledge together (Stepien & Gallagher 1993).

The main differences between traditional and PBL curriculae as well as the differences between the roles of a traditional tutor and a PBL tutor can be seen in Tables 2.3-1 and 2.3-2.

Problem-based learning (PBL) is typically organized with small groups of students, accompanied by facilitator rather than a teacher who is usually the source of solutions. From a constructivist perspective, the role of the instructor is to guide the learning process rather than provide knowledge (Hmelo-Silver & Barrows 2006). During this process, a series of problems are provided to learners with guidance early in the PBL process (with introductory problems), and then later guidance is diminished as learners gain expertise (Merrill 2002). Guidance is faded as group members feel more confident with the subject matter and become more competent with the learned procedures.

Merrill (2007) suggests beginning with worked examples and then later, introducing students to smaller less complex problems. As the process progresses, Merrill suggests changing problems and adding components to make them more realistic (Merrill 2002 & Merrill 2007). In PBL, the students determine their learning goals and develop their unique approach to solving the problem. The members of the group learn to structure their efforts and delegate tasks. Students learn to analyze their own learning processes as well as those of their fellow group members and must tackle real life problems. Finally, feedback and reflection on the learning process and group dynamics are essential components of PBL.

2.3.2.1 Problem-based learning and problem solving learning

In some disciplines, problem solving learning is well established. In this approach, the students are presented with the necessary material, usually in the form of a lecture, and then given problems to solve. These problems are narrow in focus and do not assess other key skills. This method tends to promote surface learning since the students do not get the opportunity to understanding or explore different approaches as well as evaluate their knowledge. Sweller and his associates conducted several classroom-based studies with students studying algebra problems (Sweller 1988, Sweller 2006). These studies have shown that active problem solving early in the learning process is a less

effective instructional strategy than studying worked examples (PBL) (Sweller & Cooper 1985). Active problem solving is useful as learners become more competent and better able to deal with their working memory limitations However, early in the learning process, learners may find it difficult to process a large amount of information in a short period of time Sweller and his associates suggests a worked example early, and then a gradual introduction of problems to be solved with the eventual goal of solving problems on their own. This is a form of scaffolding inherent to PBL that helps learners to slowly transit from studying examples to solving problems.

Table 2.3-1 Differences between traditional learning and PBL*

Traditional learning	PBL
Fact-collecting.	Meaning-making.
Tutor-centred: knowledge is transmitted by a tutor through tutor-driven lectures, seminars or assignments.	Knowledge is acquired by the students through a self-directed search.
Passive process.	Active process.
Individualistic process.	Collaborative process: students work in groups, and are exposed to the viewpoints and knowledge of fellow students.
Learning is based on repetition, rehearsal and memorisation, rote learning, regurgitating, and pattern-matching of content-specific tasks.	Learning is based on problem solving skills which combine factual knowledge with the use of methods to achieve goals: Goal setting (where am I going to learn it?). Strategy selection (how am I going to learn it?). Final feedback and evaluation (did it work?).
Teaching is subject-based: it works from a body of knowledge to applications.	Teaching is problem-based: it works from a problem to define the (interdisciplinary) frameworks required.
Teaching is disciplinary and disjointed.	Teaching is multi- and inter-disciplinary: it integrates and connects across disciplinary boundaries.
Students learn how to pass exams, and are given specific direction (of sources, topics etc.) on how to search for the correct answer.	Students learn to identify what information is needed to solve (or make sense of) the problem, how to frame questions about this information, formulate problems, explore alternatives, where and how to search resources, how to organise the information into a meaningful conceptual

	framework, and how to communicate the information.
The learning that takes place is mostly context-specific and short-lived. It is not adequate to prepare the students for encountering new applications or formulations.	The methods learned during problem based learning are not context-specific. They allow students to transfer knowledge to approach new and different problems. They establish life-long habits of self-directed learning.
'Problems' in traditional teaching method: When problems are used to illustrate a topic they are usually well-defined, with parameters that lead to predetermined outcomes with one preferred answer.	PBL Problems: A good PBL problem is open to many applications. Thus it enhances a skill of transferring the learning to novel situations.
When problems are used as a vehicle for learning (as in the case-study method) they are used as concrete illustrations of abstract concepts. They are introduced after relevant knowledge has been acquired.	Problems are encountered before any relevant knowledge has been acquired.
The tutor poses the questions, the tasks and the means of finding the solutions (reading lists, hand-outs etc.).	Students are empowered to take charge of the learning process: identify knowledge needed to resolve the problem, generate questions (learning issues) that target the kind of knowledge they want to acquire, and proceed to search for it using a variety of resources.
Evaluation emphasises the quality of product, based on some elaboration of the material given or directed by the tutor.	Evaluations emphasise the process of the learning and the quality of the integration of knowledge reflected in the "solution".
Traditional assessment is dominated by an exam or an essay type assignment.	PBL is assessed by "a portfolio" which contains one's diary of contribution to the PBL process, self-evaluation, and evaluation of fellow team-members along several criteria. These may include attendance, degree of preparation for class, listening and communication skills, ability to bring new and relevant information to the group, ability to ask questions that further group understanding, etc. Exam questions resemble the PBL process. Students are given a problem to analyse by resolving self-identified learning goals.

*www.ucd.ie, Dept. Of Sociology, UCD, Belfield, Dublin (2003)

Table 2.3-2 Differences between the roles of traditional tutor and PBL tutor*

Traditional tutor	PBL tutor
Setting the agenda.	Only setting the problems.
Tutor responsible for learning.	Students take responsibility for their own learning.
Tutor provides solutions and "right answers".	Tutor does not tell "the right answer" or "what to do": students are expected to provide the answers. They are given space to experiment, make mistakes, and go to original sources to get information.
Tutor is directive: giving lectures, asking questions, giving answers.	Tutor is a non-directive facilitator: a coach, a learning manager, a guide, a supportive activator of students' learning initiatives, providing guidance.
Tutor is an authorative expert.	As a facilitator, the tutor's input is to keep the process on track and proceed towards task objectives (tutor may probe students' reasoning processes, or question their logic and beliefs).
Tutor specifies bibliographic references.	Students are encouraged to explore a variety of resources in seeking the information they require. These resources may include library reference sources and the internet.

*www.ucd.ie. Dept. Of Sociology, UCD, Belfield, Dublin (2003)

2.3.3 PBL in healthcare education

PBL was developed as an alternative to traditional or teacher led education of health care professionals. The concept was introduced in the Faculty of Medicine at McMaster University in Canada in the late 1960's. Over the years, PBL spread throughout the world at institutions such as the University of Limburg at Maastricht in the Netherlands and the University of New Mexico in the United States. Implementation of PBL gradually increased during the 1970's and 1980's, whilst in the 1990's a great number of medical institutions adopted this curriculum. Today, it has been introduced into schools of dentistry, pharmacy,

veterinary medicine and nursing and can be found in universities all over the world.

There is ongoing debate regarding the effectiveness of PBL. In the early 1990's a few systematic reviews of undergraduate medical education cautiously advocated the short term and long term outcomes of PBL compared with traditional learning (Norman & Schmidt 1992, Albanese & Mitchell 1993, Berkson 1993,Vernon & Blake 1993,). There was very little research available on whole curriculum level, although a number of educators believe that PBL interventions have to encompass to the whole curriculum to show significant benefits (Colliver 2000). As a result the evidence was mainly provided by case studies, uncontrolled evaluation studies, or comparisons of short educational interventions based on PBL. Since then many medical and dental curricula have changed to PBL in undergraduate health education. Recently, a number of controlled studies were published which focussed not only on the effect of PBL before but also after graduation (Peters *et al.* 2000, Shmidt *et al.* 2006).

All the recently published articles were included in a pilot systematic review that was released in 2003 on behalf of the Campbell collaboration (Newman 2003). This review concluded that there is limited high quality evidence about the effectiveness of different types of PBL in different contexts with different student groups. During the same year Dochy *et al.* (2003) published a meta-analysis of the possible effects of PBL on knowledge and skills. The review concluded that PBL has a positive effect on the skills of students and a slightly negative effect on knowledge. Recently, Koh *et al.* (2008) constructed a systematic review of studies primarily investigating effects of PBL on physician competency after graduation. The results of this review showed that PBL has positive effects, mainly in social and cognitive dimensions.

Systematic reviews are considered to be valid and reliable method of summarising and appraising the existing literature. 'Such a review limits

the bias that may exist in studies that are specific to time, sample and context, or are of questionable quality' (Newman 2003). The purpose of this systematic review is to investigate and categorise the existing evidence regarding the short and medium term effectiveness and the reported benefits or drawbacks of PBL in health education. This review will focus on comparative studies within undergraduate education of health care professionals and aims to categorise existing research in terms of study design and potential impact. Although the majority of the research about the effectiveness of PBL emanates from medical education, a number of articles have been recently released investigating its effects on the dental as well as other areas of health care education.

3 Problem Based Learning in Academic Health Education: A systematic literature review.

3.1 Materials and methods

3.1.1 Search parameters

This systematic review focused on the following types of articles:

- Present original research within healthcare education.
- PBL in research settings compared with other educational method, either at a whole curriculum level or as a single intervention.
- The experimental methodology is clearly described, as well as the outcome parameters which are evaluated.
- Outcomes that are evaluated can be both qualitative and quantitative.

The literature review was executed in the electronic databases PubMed, ERIC and PsycLIT. PubMed includes peer-reviewed journals in healthcare sciences, ERIC is an internet based digital library of education research and information. Finally PsycLIT is a CD-ROM version of Psychological Abstracts.

The following keywords and combinations of keywords were used: "PBL AND traditional", "PBL AND conventional", "PBL AND comparison", "PBL AND effectiveness".

The database search was supplemented with manual search of the electronic archives of the following journals: Academic Medicine, Medical Education, Teaching and Learning in Medicine, Journal of Dental Education, and European Journal of Dental Education. The review covered the period 1976-2008.Finally, the reference lists of the selected articles were searched for possible additional articles. Several review articles and theoretical overviews were also retrieved for this purpose.

3.1.2 Selection process

Three dental educators were involved in the selection of articles for this review. Five previous reviews were used as a guide in addition to the obvious indicators or methodological criteria like sample size, response rate and randomization, our decisions were also based on somewhat more subjective criteria like reaching a consensus after assessing the papers. No decision was made based on intervention criteria since there was no description of the intervention in the majority of these papers.

A keyword database search, as well as expanded journal search provided us with 1233 articles. 795 of these articles were excluded based on information provided in the title. The abstracts of 438 articles were carefully reviewed and further selection was based on the extracted information. This exclusion left us with 69 articles that appeared suitable for our review. Unfortunately, it was not possible to obtain the full text of all 69 articles and so a further 17 of them were excluded.
Both qualitative and quantitative evaluations were included in the review, however due to the different nature of the evaluation the 13 studies that utilized solely qualitative approaches were analysed and discussed separately.

The analysis was based on 39 studies, which completely fulfilled the selection criteria. Based on the study design, these studies were further classified into:

I. **Randomised Controlled Trials (RCT n = 6)**
   a. Whole curricula comparisons (n = 4), (Table 3.2-1).
   b. Single educational interventions of shorter duration (n = 2), (Table 3.2-2).

II. **Comparative studies (n=33)**

a. Whole curricula comparisons (n = 26), (Tables 3.2-5, 3.2-6, 3.2-7).

b. Single educational interventions of shorter duration (n = 7), (Table 3.2-8).

The selected studies were further categorised according to the following elements or characteristics (Table 3.2-1, 3.2-2, 3.2-5, 3.2-6, 3.2-7, 3.2-8).

i. First author and year of publication.
ii. Study educational environment.
iii. The number of students that participated in the study.
iv. Methods that were used to evaluate the results.
v. Principal outcomes of the research.

3.2 Results

3.2.1 RCT; whole curricula and single educational interventions

Four randomised controlled studies between whole curricula were found (Peters *et al.* 2000, Mennin *et al.* 1993, Moore *et al.* 1994, Schmidt *et al.* 1996) (Table 3.2-1), while two more addressed single educational interventions (Tans & Schmidt 1986, Antepohl & Herzig 1999) (Table 3.2-2). Most of the studies, gave little or no information regarding the curriculum design (both PBL and traditional) or the way this was delivered. Furthermore, there were marked differences in the way the outcomes were evaluated.

In the whole curricula comparison level, two studies mainly evaluated outcomes related to various types of test scores, while one assessed further elements such as personal characteristics and subjective approaches to learning and experiences. The most recent one evaluated the effects of PBL after graduation. The single intervention studies mainly assessed multiple choice questions scores.

In the study by Schmidt *et al.* (1996), PBL is compared to a conventional as well as to an integrated curriculum. This integrated curriculum employed some small group learning in which knowledge previously acquired is applied to relevant clinical cases but students are not considered to be self directed. Results showed no overall differences in student performances between the integrated and the PBL curriculum and a significant difference in favour of these two when compared with a conventional curriculum Schmidt *et al.* (1996). Schmidt *et al.* (1996) asks an important question; "What do the PBL and integrated curricula have in common that makes their effects on students similar, and what distinguishes them from the conventional?" The answer is that both the former curricula offer knowledge to the students in an integrated fashion but contrary to the conventional curriculum, the processing of this information is promoted through small-group discussions during a number of PBL sessions Schmidt *et al.* (1996).

At this level, a modest advantage of PBL is observed when it comes to relational skills, humanistic attitudes and diagnostic accuracy, although these observations are based on only two of the studies (Peters *et al.* 2000, Moore *et al.* 1994). In terms of test scores however, the studies showed no difference at the short-term results, while one study suggested an advantage of PBL students in the medium term (Mennin *et al.* 1993). Self directed learning is primarily advocated to help students acquire the skills for life long, self-driven learning. According to the study by Peters *et al.* (2000), PBL seems to have a good effect on several competencies after graduation but no significant effects were observed in life-long learning attitudes.

3.2.2 Comparative studies; whole curricula and single interventions

A series of comparative studies were conducted over the last 30 years, either on a curricular level or as single interventions in a curriculum. At this level, the major difference is that students are not randomly

assigned into a programme or intervention. Interestingly, their outcomes differed significantly (Table 3.2-3, 3.2-4). Twenty six of the studies identified dealt with a whole curriculum (Table 3.2-5, 3.2-6, 3.2-7), while seven studied shorter programmes, courses or educational interventions (Table 3.2-8).

From the studies that dealt with the whole curriculum, I can conclude that PBL seem to provide a flexible learning process which enables the students to decide their own learning agenda and help them in the accumulation of knowledge (Coles 1985, Shuler & Fincham 1998, Blake *et al.* 2000, Jones *et al.* 2002). Better results in critical reasoning, problem solving abilities and creativity also suggest advantages of PBL in key areas of the education (Boshuizen & Schmidt 1993, Hmelo 1998, Rolfe *et al.*1995). In addition and according to several studies reviewed, PBL is described by the students as an enjoyable way of learning (Coles 1985, Kaufman 1989). There seems to be a possible disadvantage for the PBL students with respect to factual knowledge of basic sciences but most of the studies that demonstrated this used multiple choice questions (MCQ) to assess PBL which for some authors is incongruent with the aims of PBL (Imbos *et al.* 1984, Kaufman *et al.* 1989, Baca & Mennin 1990).
The results from comparative studies in undergraduate curricula (single PBL intervention) were almost always in favour of PBL interventions. Once again, MCQ tests were used in the majority of these studies.

Table 3.2-1 Randomised controlled trials (Whole curricula comparisons)

Authors & Year	Environment	n PBL/Conv	Assessment parameters	Main outcome
Mennin *et al.* 1993	New Mexico School of Medicine	411 + 1268	Test scores: i) NBME I ii) NBME II, III iii) Relationship between the three steps of NBME exams and between NBME and other exams like (MCAT) and (SGPAs) MCAT: Medical college admission test. SGPAs: Undergraduate science grade point averages	i) Conventional: Significantly* better mean scores at NBME I ii) PBL: Better mean scores at NBME II and significantly* better at NBME III iii) For both tracks, strong relationships were found between the scores of the three exams. For the PBL curriculum students, significantly weaker relationships were found between mean SGPAs and mean scores on the three exams. For both tracks, MCAT scores, were predictive of performances on the NBME I and II.
Moore *et al.* 1994	Harvard Medical School	60 + 61	i) Preclinical students' knowledge ii) skills, iii) personal characteristics, iv) approaches to learning v) educational experiences	i) No significant differences, ii) No difference in problem solving skills but PBL: better relational skills, iii) PBL: more humanistic attitudes, iv) PBL: preferred active learning, v) PBL: Felt more challenged and satisfied.
Schmidt *et al.* 1996	Medical University of Limburg (PBL), Amsterdam (Integrated) and Groningen (Traditional)	610	Diagnostic Performances	Overall, the students from the conventional medical school performed poorer than those from the other two schools. Students from the integrated curriculum performed better than the other two groups in the second and third curriculum years. Students from the PBL and integrated curriculum performed better than the conventional in the fifth and sixth year. (All significant differences)*
Peters *et al.* 2000	Harvard Medical School	50/50	Telephone interviews to evaluate long term effects of PBL on behaviours and attitudes related to humanistic medicine, lifelong and social learning. 22 measures were evaluated on the survey	Significant* differences in only 5 measures.

*Statistically significant differences when available are marked with an asterisk

Table 3.2-2 Randomised controlled trials (Single educational interventions)

Authors & Year	Environment	n PBL/Conv	Assessment parameters	Main outcome
Tans and Schmidt 1986	Physiology course for Physiotherapists. The Netherlands	77/45	i) MCQ test directly after the course ii) MCQ test 10 weeks after the course	i)Direct instruction group performed better. ii) PBL group performed better (Both significant differences)*
Antepohl and Herzig 1999	University of Cologne, Pharmacology course for medical students	63/60	i) MCQ ii) Short essay questions	i) No difference ii) No difference with a tendency favouring PBL

*Statistically significant differences when available are marked with an asterisk

Table 3.2-3 Outcomes of comparative studies whole curriculum

Favourable to PBL	Favourable to Conventional	No major Differences
Imbos *et.al* 1984	Neufeld & Sibley 1989	Woodard & McAuley 1983
Coles 1985	Baca *et al.* 1990 *	Jones *et al.* 1984
Kaufman *et al.* 1989 *		Farquhar *et al.* 1986
Boshuizen *et al.* 1993		Santos Gomez *et al.* 1990
Shin *et al.* 1993		Goodman *et al.* 1991
Mennin *et al.*1996		Tolnai 1991
Richards *et al.* 1996 *		Block and Moore 1994
Hmelo 1998 *		Rolfe *et al.* 1995
Shuler *et al.* 1998 *		Albano *et al.* 1996
Blake *et al.* 2000 *		Login *et al.* 1997
Jones *et al.* 2002 *		Distlehorst & Robbs 1998
Gurpinar *et al.* 2005 *		Kaufman & Mann 1998
Iputo & Kwizera 2005 *		Verhoeven *et al.* 1998
Rich *et al.* 2005 *		Last *et al.* 2001
Tamblyn *et al.* 2005 *		Prince *et al.* 2005
Schmidt *et al.* 2006		

*Statistically significant differences when available are marked with an asterisk

Table 3.2-4 Outcomes of comparative studies single PBL interventions

Favourable to PBL	Favourable to Conventional	No major Differences
Barrows & Tamblyn 1976 *		Michel *et al.* 2002
Nolte *et al.* 1988		
Eisenstadt *et al.* 1990 *		
Hmelo *et al.* 1997 *		
Schwartz *et al.* 1997		
Mc Parland *et al.* 2004 *		

*Statistically significant differences when available are marked with an asterisk

Table 3.2-5 Comparative studies A (Whole curricula comparisons)

Author/Year	Nature of education	Number of students PBL/Conv.	Variables	Outcome
Woodward *et al.* 1983	Medicine	105/47	Assessed by supervisors	Supervisors characterise graduates from PBL school as better communicators with patients but no other significant differences were reported.
Imbos *et.al.* 1984	Anatomy	Not reported (NR)	Anatomy subtests out of 28 different Progress tests	Students on a non-PBL curriculum show a steeper increase in knowledge during the period in which anatomy is lectured. After that they show a slight decrease whereas the students of a PBL curriculum still show a steep increase.
Jones *et. al.* 1984	Health Sciences	63/138	NBME I	Overall, no significant differences.
Coles 1985	Medicine	NR	Short inventory of approaches to studying	PBL may be creating an educational climate which enables students to learn in a desirable manner.
Farquhar *et al.* 1986	Medicine	40/40	NBME Part I exam	No significant differences on total test scores.
Kaufman *et.al.* 1989	Medicine	NR	NBME I, NBME II, clinical clerkships, stress levels.	PBL students scored significantly* lower on the NBME I and significantly* higher in the NBME II. Overall the clerkship scores of PBL students were lower in the early years and higher during the later years. PBL students experienced less distress.
Neufeld & Sibley 1989	Health Sciences	NR	First try pass rate EMC	Somewhat favourable results with conventional curriculum

Table 3.2-6 Comparative studies B (Whole curricula comparisons)

Author /year	Nature of education	Number of students PBL/Conv.	Variables	Outcome
Baca *et al.* 1990	Medicine	37/41	NBME I	Significantly* better result with traditional curriculum
Santos Gomez *et al.* 1990	Medicine	52/133	Residency performance on 8 dimensions	Similar performances in most dimensions
Goodman *et al.* 1991	Medicine	18/102	NBME Part I, NBME Part II, Oral exam.	No significant differences
Tolnai 1991	Medicine	156/186	Attitude to and participation in continuing medical education	No significant differences
Boshuizen *et al.* 1993	Medicine	4/4	1 case	Better results with PBL
Shin *et al.* 1993	Medicine	48/48	Keeping up to date with current clinical practice guidelines	Better results with PBL
Block & Moore 1994	Medicine	62/63	NBME I	No significant differences
Rolfe *et al.* 1995	Medicine	49/335	Clinical competence of interns assessed by supervisors	Similar results in most competencies.
Albano *et al.* 1996	Medicine	NR	Progress test	Similar results
Mennin *et al.* 1996	Medicine	40/100	Self assessment in 17 competencies	'Track differences favourable to the PBL were evident in relation to the major goals established by the program: to attract graduates to careers in primary care in rural and underserved areas and to provide graduates with self directed lifelong learning skills'.
Richards *et al.*1996	Medicine	88/364	4 clinical rating scales and NBME	PBL students received significantly* higher ratings from house-staff and faculty on all four rating scales. No difference in scores on the NBME medicine self test was observed.
Login *et al.* 1997	Dentistry	20/20	Oral comprehensive exam	No significant differences
Distlehorst & Robbs 1998	Medicine	47/154	The graduating classes' performance on a number of outcome measures.	Students in the PBL curriculum performed at least as well as, and in some instances better then their counterparts in the standard curriculum.
Hmelo 1998	Medicine	19/17	6 medical problems	Students in a PBL curriculum are moving along the path to novice physician more rapidly than students in a traditional curriculum.*

Kaufman & Mann 1998	Medicine	162/81	MCC qualifying examination Part I
Shuler *et al.* 1998	Dentistry	12/130	NDB I
Verhoeven *et al.* 1998	Medicine	1904/1089	Progress tests

Table 3.2-7 Comparative studies C (Whole curricula comparisons)

Author/Year	Nature of education	Number of students PBL/Conv.	Variables	Outcome
Blake *et al.* 2000	Medicine	357/220 256/193	USMLE Step 1 USMLE Step 2	' PBL not only did not compromise the performances of medical students on the exams but may have contributed to higher scores. Most of the differences were significant'.*
Last *et al.* 2001	Dentistry/ Basic Sciences	59/51	40 part true/false Questionnaire	No significant difference
Jones *et al.* 2002	Medicine	138/123	Questionnaire (Self/supervisor) designed to measure perceptions of levels of preparedness for the role of pre-registration house officer	Graduates rated the PBL significantly more effective for 12 of the 19 broad competences and eight of the 13 specific skills that were listed. There was a statistically significant difference in favour of the PBL between the ratings of graduates for five of the 18 listed competencies but not for any of the specific skills.*
Iputo & Kwizera 2005	Medicine	145/149	Attrition rate, Throughput rate	The introduction of PBL may have contributed to the improvement of academic performance*
Gurpinar *et al.* 2005	Medicine	56/78	MCQ test	PBL students were significantly more successful*
Rich *et al.* 2005	Dentistry	274/234	Test scores in preclinical (midterm and final exam) and clinical periodontics	Significant differences* favouring the PBL for the midterm and final exams, but not for the clinical exam.
Prince *et al.* 2005	Medicine	239/920	Questionnaire self assessment in 12 general competencies	The results suggest that the PBL school provided better preparation with respect to some competencies but overall no significant differences were detected.
Tamblyn *et al.* 2005	Medicine	151/600	Annual performance in preventive care, continuity of care, diagnosis, and management. Assessed by administrative database	Transition to PBL was associated with significant* improvements in preventive care and continuity of care and an improvement in indicators of diagnostic performance
Schmidt *et al.* 2006	Medicine	820/621	To rate themselves on 18 professional competencies Questionnaire	Graduates of PBL rated themselves more highly on 14 of 18 competencies

*Statistically significant differences when available are marked with an asterisk

Table 3.2-8 Comparative studies (Single educational interventions)

Author	Duration	Nature of education	Number of students PBL/Conv.	Variables	Outcome
Barrows & Tamblyn 1976	One –to two-hour tutorial session once a day for three days.	Neurology	10/10	Standardized Patient simulation	'The PBL groups demonstrated better results in problem formulation (lesion localization and aetiology), better use of self study and also showed greater motivation'.*
Nolte *et al.* 1988	NR	Neurobiology course	240/120	NBME	'Students were found to learn as effectively and to enjoy themselves more, when the new format was implemented '.
Eisenstadt *et al.* 1990	3-4 weeks	Haematology / Transfusion	32/58	MCQs	'Students in the tutorial scored significantly* lower in the initial exam but their performance remained constant over a two year interval. Scores in the controls dropped significantly'*.
Hmelo *et al.* 1997	(For PBL group)10 for 10-12 weeks and 10 for 32 weeks	The case of a Diabetic child	20/20	Reasoning strategies, coherence, use of science concepts, learning self assessments and learning plans	'A greater* use of hypothesis driven reasoning and greater coherence* in the PBL group. PBL students developed learning strategies that should allow them to continue to learn well beyond medical school'.
Schwartz *et al.* 1997	3 times/week for 10 weeks	Surgical clerkship	NR	3 MCQ quizzes, a MCQ final exam, a standardized patient exam and modified essay exams	'No significant differences between the PBL and the conventional groups with respect to their knowledge base, but PBL group possessed better problem –solving skills and greater clinical competence'.
Michel et al. 2002	40 hours	Basic Pharmacology	31/76	30 question multiple choice exam	Slightly better results with PBL
Mc Parland *et al.* 2004	8 weeks	Psychiatry	191/188	2 end of attachment examinations, a MCQ paper and a viva	'The PBL curriculum resulted in significantly* better examination performance than did the traditional curriculum'.

*Statistically significant differences when available are marked with an asterisk

3.3 Discussion and conclusions

The present review has attempted to organise the existing evidence into categories, based on the study design.

It is argued by many that PBL can unfold its full potential when applied over a period of a whole curriculum. Many also believe that in educational research, randomised control trials on a curriculum level are the only studies that can provide convincing evidence that PBL improves knowledge base and clinical performance (Colliver 2000). It was therefore reasonable to identify the few available RCTs on a curriculum level as the most potent attempts to investigate PBL in relation to conventional teaching methods.

Within most research fields where the use of the RCT is feasible, it is generally acknowledged as representing the gold standard of evaluative research (Torgerson 2002). Torgerson strongly called for more large good quality RCTs. This has been challenged by several researchers. Norman & Schmidt (2000) believe that using RCT for researching curriculum interventions is an approach that is "doomed to fail". The fundamental problems with RCTs in education are that at the level of the curriculum it is impossible to standardise the intervention and that students are never blind to the intervention. Another issue is the control of variables. Factors like resources, student motivation, facilities and many more can affect the process. It is theoretically possible to control for such variable, but according to Prideaux (2002); "by doing so the key factors that determine the success or failure of the intervention may be removed". The third issue concerns the choice of appropriate outcome measures since there is no definition of clear outcomes for health education research (Prideaux 2002). In the absence of consistent measurable outcome differences between PBL and conventional teaching, some have argued this is not a reasonable expectation for a PBL curricula (Albanese 2000, Ferguson 2005).

According to Morrison (2004), one of the reasons it is difficult to detect differences, is that medical students are an elite group of individuals proficient at passing examinations, irrespective of teaching method. Another explanation could be that because schools have different admission policies, students may have different characteristics at the outset which may influence further knowledge and skills (Schmidt 1998). It should be noted though that some studies in the past and more in the last few years are examining possible relationship between admission tests/policies and performances of the students before and after graduation.

From the results of this review it is reasonable to conclude that at the RCT level, no clear difference is observed between PBL and conventional teaching when test scores were compared. There was also no difference in terms of biomedical knowledge, when such a test was applied (Moore *et al.* 1994). Only one study suggested better medium term knowledge retention in PBL students (Mennin *et al.* 1993). A modest advantage was attributed to PBL in two studies where qualities such as humanistic attitudes, relational skills and diagnostic performances were evaluated. Nevertheless, the underlying mechanisms of such differences remain unclear (Moore *et al.* 1994). It is worth noting that in the study by Schmidt *et al.* (1996), the students from the integrated curriculum performed better than those from the conventional and PBL curricula.

Most of the studies that took place in the 1980's (Table 3.2-5), used exams like National Board Medical Examination (NBME) (MCQ examination) as a way of evaluating the effectiveness of each curriculum. This type of exam rarely showed any significant differences between the two interventions. In the 1990's (Table 3.2-6) more studies were constructed and NBME I and II exams (later US Medical Licensure Examinations) continued to be used as a method of detecting differences in student performances between different curricula. In addition, there were many studies focusing on stress and perceptions of the learning environment, clinical performances, communication with

the patients and progress tests. It was mainly when these variables were evaluated that the results were more favourable to PBL. With the introduction of USMLE in 1993, the style and focus of the exam changed and questions took on a 'clinical context' (Albanese 2000). There is not yet convincing evidence that USMLE is sensitive to the effects of PBL but the results of Blake *et al.* (2000) study appear to be promising. These results showed that implementation of a PBL curriculum at the University of Missouri might have contributed to higher scores in the licensing examinations and did not compromise the attainment of basic science and clinical knowledge (Blake *et al.* 2000).

Another parameter that should be taken into consideration when reading the literature and analysing the results, is the tendency for performance to initially improve when a new curriculum is instituted, not because of any actual improvement in learning or achievement, but in response to increased interest in the new curriculum (Novelty Effect) (Friedman 1979, McCall and Carriger 1993). Although PBL cannot be considered new nowadays, a large number of the studies that were included in this review took place in the 1980's and 1990's, a period in which many of schools adopted the new curriculum. Furthermore, a number of universities are using these studies to evaluate PBL a year or two after they adopted it. In addition, PBL is believed to be more expensive than traditional curricula especially in large schools (Berkson 1993, Winning & Townsend 2007). Perhaps the increased expense involved leads to a demand for evaluation of PBL curricula so as to justify the change on a "value for money basis".

What is interesting about comparative studies in undergraduate curricula (single PBL intervention) is that the results were almost always favourable to PBL interventions. This was not the case when the whole curricula were PBL. As a result, it would be interesting to research the possibility of PBL being more effective in a traditional curriculum as multiple interventions. One could speculate that lectures highlight important objectives for successfully answering the MCQ questions and as a result offer a more efficient means of exam preparation in the short

term. When PBL is used as single intervention in a lecture based curriculum, it is possible that it improves the students' ability to learn during the teaching sessions by helping their long-term retention of information as well as their critical thinking. If this is true, could it be possible that multiple PBL interventions in a traditional curriculum are more effective than a PBL curriculum? Schwartz *et al.* (1993) urges the medical schools that are thinking of converting entirely to a problem based learning format, to use caution and adopt a middle ground in order to retain the benefits of a traditional curriculum while gaining some of those of PBL. This suggestion was based on findings in the literature and his own experience.

This review indicates that PBL has a number of positive effects in key areas of student education but there is limited high quality evidence to prove its superiority over the teacher led education. There is also a suggestion that "hybrid" curricula can deliver equally well in most issues.

Dolmans (2003) believes that in order to learn more from research on PBL; first the "objectivistic view of science needs to be extended with the constructivist view of science". Since PBL as an intervention has several interacting components, a research direction would be to investigate these interactions and the possible effect they might have on learning. We should concentrate on the reason why and under which conditions the educational interventions are effective instead of just being interested in measuring their effectiveness (Dolmans 2003). Designing and implementing studies that investigate the effects of interactions between variables could help us understand the effects of such interaction on the effectiveness of a particular intervention. Such studies would help us explore the relationship between theory and practice. However, this might not be possible without altering the effects and qualities of the PBL intervention itself (Dolmans 2003, Mamede *et al.* 2006).

Referring to the views of Dolmans (2003), Newman *et al.* (2004) stated that he does not reject the constructivist approach to research. He believes that qualitative studies have a role since they help us understand the way different approaches to PBL operate. However, unlike randomised controlled trials, qualitative studies do not tell us whether these approaches will lead to the intended learning outcomes. Although several researchers over the years have questioned the value of large randomised trials of curriculum-level interventions (Koh *et al.* 2008, Torgerson 2002) an equal number have supported their use in order to answer the question of relative benefits (Dolmans 2003). It appears that both groups agree that further research is needed.

Advocates of PBL believe its interactive nature provides students with the necessary skills to continue their own education through self-directed learning. Rapid advances in medical knowledge make it important for clinicians to keep up-to-date through continuing education courses. There is some evidence that interactive sessions can benefit professional practice but these benefits have not yet been shown in both medium and long term. As a result, the factors which influence the attitude of the practicing dentist towards life-long learning remain largely unknown (Peters *et al.* 2000, Shin *et al.* 2000, Ferguson 2005).

3.4 Publication details

This review was accepted for publication in the European Journal of Dental Education on the 16th June 2009 (Appendix 8-1).

4 The role of the curriculum and other factors in determining the medium to long term attitude of the practicing dentist towards life-long learning

4.1 Introduction

Dentistry is a profession with an ever expanding knowledge base. As a result, standards of care are continuously evolving and advancing. For those standards to be fulfilled, it is imperative for the dental professionals to be life-long learners. Life-long learning today is perceived as a dynamic process, inseparable from everyday clinical practice. Underpinning such a process is the individual's attitude to continuously assess the outcome of professional actions and subsequently define and pursue his or her individual learning needs. Consequently, life-long learning is an attitude which should be targeted by every undergraduate dental curriculum.

Although little is known as to how this attitude and the related skills are ideally taught and developed, advocates of Problem Based Learning (PBL) believe that due to its structure, it enables the students to be better prepared for self directed, life-long learning than graduates of conventional curricula (Peng 1989). Evidence to support this claim is limited due to the small number of available studies and the obvious difficulty to control variables such as student motivation and resources. In addition, the role that other factors can have after graduation on the establishment and implementation of a life-long learning attitude remains largely unexplored.

Recognising the importance of the life-long learning attitude, the University of Toronto, Faculty of Medicine revised its conventional lecture based medical curriculum in 1992. A "hybrid" was created by introducing small group, PBL and Self Directed Learning (SDL) opportunities. According to Harvey *et al.*, the University implemented

these changes in order to achieve the following ideals described by Barrows in 2000; "Students would be stimulated by the experience, would see the relevance of what they were learning to their future responsibilities, would maintain a high degree of motivation for learning and would begin to understand the importance of responsible professional attitudes" (Harvey *et al.* 2003). Harvey *et al.* designed a study aiming to investigate if this curricular revision positively influences the students' self-reported SDL (Harvey *et al.* 2003). A questionnaire package was mailed to 280 randomly selected students, 70 from each of the four years of the curriculum. This package contained two validated instruments of SDL. No evidence was found that students' self reported SDL was positively influenced by the undergraduate curriculum. However they did identify a significant positive trend in SDL with the highest level of premedical education achieved.

In 1985, Harvard Medical School introduced the New Pathway program (NP), a primarily PBL, undergraduate curriculum that sought to promote, among other things, positive attitudes toward active, self-directed learning (Peters *et al.* 2000). Survey items were developed to measure these attitudes and comparisons were made with graduates that had studied the traditional curriculum before the introduction of NP. Results showed no statistically significant difference between NP and traditional graduates' attitude towards life-long learning.

In 1991, a survey was conducted by Tolnai among graduates of two Canadian medical schools. The respondent graduates had been in practice from 9 to 15 years. He tried to test the hypothesis that 'graduates from a PBL curriculum differ from graduates of the traditional curriculum in their attitude to their participation in continuing medical education (CME) activities'. A survey instrument was designed asking questions in eight categories. Results indicated that 'the undergraduate curriculum had no decisive influence upon the learning habits of the graduates'.

Another survey by Shin *et al.* attempted to compare 'how well graduates of a PBL and of a traditional curriculum who subsequently follow a career in primary care keep up to date with current clinical practice guidelines' (Shin *et al.* 1993). Hypertension was chosen as the representative disorder because it is a common medical problem and new guidelines had been published. Shin *et al.* also took into consideration that a previous survey had shown that 'time since graduation was strongly negatively correlated with knowledge of its management' (Evans *et al.* 1984, Evans *et al.*1986, Ramsey *et al.* 1991) The mean scores for all of the components of the questionnaire were higher for the PBL graduates than for those of the traditional curriculum (5 components). These differences were statistically significant for two out of the five components.

Life-long learning attitudes have been investigated in several studies designed to compare PBL with a traditional curriculum. They are usually included among other cognitive competencies thought to be important for the students to acquire before graduation (Menin *et al.* 1996, Hmelo *et al.* 1997, Schmidt *et al.* 2006). However, none of these studies could provide sufficient evidence to support the suggestion that these attitudes can be influenced by the type of undergraduate curriculum.

The current study aimed to investigate if the undergraduate curriculum instructional approach (PBL, hybrid or didactic conventional teaching) is a significant factor in determining the medium to long-term attitude of the practicing dentist towards life-long learning. It also aimed to identify the factors after graduation and the professional characteristics which may influence this attitude. In addition an attempt was also made to collect potentially important demographic and professional data.

4.2 Materials and methods

Ethical approval was attained from the faculty research ethics group faculty of health sciences, Trinity College Dublin. The experimental study was executed through a specially designed questionnaire

(Appendix. 8.2) Twelve cohorts of graduates from the dental faculty in Dublin were utilised, having graduated from 1994-2005. The oldest cohorts group A (1994-1997) completed a fully didactic curriculum, the middle cohorts group B (1998-2001) a mixture of both while the other cohorts group C (2002-2005) completed an exclusively PBL curriculum. The total sample was 379 dentists. Admission process has been unchanged over the (1994-2005) period.

The survey instrument included 34 questions in four categories. The questionnaire included simple questions, Multiple Choice Questions, Visual Analogue Scales or combinations of both. The questions inquired about: current professional activities; postgraduate training; speciality certification; practice type; hospital affiliation; computer use; time spent in various CDE activities; participation in CDE courses, local conferences, meetings etc. Additionally, various topics related to dentistry were used to assess if practitioners were up to date in the latest practice guidelines and protocols in the management of certain medical/dental conditions. As a result, the questionnaires were sent only to dentists that were practicing in the Republic of Ireland and the UK where guidelines and protocols are very similar. Finally, four VAS type questions were given to the graduates in order to express their feelings about their undergraduate studies and the way these studies affected their ability to practice dentistry, communicate with their patients and keep up to date. Five dentists, (two experienced in educational research) and a statistician were involved in designing of this questionnaire and care was taken to make sure that the questions effectively communicated the relevant information so results could be easily and efficiently analysed. The questionnaire was piloted to 10 members of staff in the Dublin Dental School and Hospital and following minor amendments (limited the demographic questions), it was mailed to the participants in a pre-stamped and pre-addressed envelope for self-completion with an explanatory note which also addressed the question of anonymity (Appendix. 8.3) Follow up efforts were made to reach those dentists that did not initially reply or whose address had changed in the intervening period.

Altogether 379 questionnaires were mailed and the initial response rate was 37.20% for group A (49/131), 39.23% for group B (51/130) and 54.23% for group C (64/118). After the second follow up effort, the number of responses increased to 50% for group A (66/131), 56% for group B (73/130), and 63% for group C (74/118). The third and final follow up yielded the following response rate: group A, 59%, (77/131), group B, 59%, (77/130) and group C, 69%, (81/118).

7 questionnaires (1 from group A, 1 from group B and 5 from group C) were improperly filled and 1 questionnaire arrived when the statistical analysis was already complete. All 8 of them were excluded from the study. The final number of questionnaires that could be used for the statistical analysis were as follows:

- Group A (76/131) **58%**
- Group B (76/130) **58,4%**
- Group C (76/118) **64%**

All data were recorded using a Microsoft® Excel 2007 (Microsoft Inc., Redmond, WA, USA). Statistical analysis was carried out using JMP version 8 for Windows® statistical software (JMP Inc. SAS Campus Drive, Cary, North Carolina, USA). Contingency analysis of the results started with selected crosstabs of some demographic variables with some continuous education variables as well as the guideline adherence topics. In statistics, contingency tables are used to record and analyze the relationship between two or more variables, most usually categorical variables. Since the proportions are not identical, the statistical significance of the difference between them can be tested with a Pearson's Chi-squared test or a Fisher's exact test if the sample sizes are small. The distributions of the variables in our data were compared using chi square tests. The degree of association was measured by the Pearson's χ^2 values. If this was above 0.05 then there was no association between the column and the row variable. If it was less than 0.05 then it would be worth exploring.

Analysis continued by comparing the final set of questions (Visual Analogue Scales/ Self evaluation), by the initial demographic factors and the professional variables and finally the continuous education variables with the professional variables. As the distribution of these variables was non-normal, a non-parametric analysis was used. (Kruskal-Wallis).

Following on from the questionnaire, a cohort of 12 dentists were interviewed in order to tease out further information regarding their responses. Care was taken to ensure that those interviewed were representative of the initial sample. Interview questions were designed specifically for this purpose with the assistance of a psychologist (Appendix 8.4). Two pilot interviews were carried out which were subsequently excluded from the final analysis. Interviews were carried out by telephone or face to face by the principal researcher and recorded in a Microsoft® Word 2007 (Microsoft Inc., Redmond, WA, USA) document.

4.3 Results

The majority of respondents were single (54%), females (54%) with no children (72%). 74% of them were general dentists and 34% of them were working as dental associates. Of those dentists that currently own their own practice (24%) it took an average of 4.2 years to achieve this. The majority of dentists are working in a city (52%) and earn more than € 5000 per month (69%).

Only 12 % of the dentists subscribe to more than one journal and only 18% would devote more than 10 days a year to their continuous education. 62% of them think that conferences are the most effective way for them to keep up to date with the latest professional developments. Journals and hands on courses are also rated high in their choices. Conversely, personal study and working part time in a dental school were not. Distributions and basic analysis of all the data collected from the questionnaire can be seen in Appendix 8.5.

4.3.1 Effect of curriculum

4.3.1.1 Contingency analysis of continuous education variables with type of curriculum.

Although there were some differences between the different curricula, they never reached statistical significance. From the results, there was a tendency for more dentists who qualified from a traditional or a hybrid curriculum to subscribe to dental journals (35.42 %) than those who qualified from the PBL curriculum (29.17%). Similar results were obtained when on-line access and membership to dental societies and/or associations were examined. PBL graduates tended to have higher attendance at conferences but also tended to attend hands on courses less. In the question of "how many days did you devote last year to continuous education?" there was a trend toward graduates from the hybrid course to report higher values. 26.32 % reported that they had devoted more than 10 days compared to only 9.21% from the traditional and 19.74% from the PBL curriculum. Additionally, only 3.95 % reported that they did not devote any time at all to their continuing education compared to 9.21% of the PBL group. These findings are of interest as the χ^2 values for the contingency table approached significance. (p= 0.06).

Table 4.3-1 Contingency analysis of number of days devoted to CDE the last year by curriculum

Count Col % Row %	None	1-5 Days	5-10 Days	10+ Days	
Traditional	3 23.08 3.95	45 36.59 59.21	21 42.00 27.63	7 16.67 9.21	76
Hybrid	3 23.08 **3.95**	36 29.27 47.37	17 34.00 22.37	20 47.62 **26.32**	76
PBL	7 53.85 9.21	42 34.15 55.26	12 24.00 15.79	15 35.71 19.74	76
	13	123	50	42	228

Only 3.95% of the graduates from the hybrid curriculum reported not to have devoted any time at all to CDE in the last year. 26.32% of them reported that they have devoted more than 10 days.

Table 4.3-2 Chi-squared values for the 4.3-1 contingency table

Test	Chi-squared	Prob>ChiSq
Likelihood Ratio	12.468	0.0523
Pearson	12.069	**0.0605**

4.3.1.2 Contingency analysis of scores from responses to dental/medical questions answered with type of curriculum.

Five questions were given to the graduates in order to test their knowledge in dental subjects that have been extensively featured in recent Journals and CDE lectures, in the form of suggestions or proposed guidelines. Again, although there were some differences between the different curricula, they never reached statistical significance. Results from only one out of the five questions came very close to reaching statistical significance (p= 0.057). In this question, results were favourable to the hybrid and the conventional curriculum.

Table 4.3-3 Contingency analysis of responses on the question regarding the treatment of patients on IV bisphosphonates by curriculum

Count Col % Row %	Wrong answer	Correct answer	
Traditional	47 30.72 61.84	29 38.67 **38.16**	76
Hybrid	47 30.72 61.84	29 38.67 **38.16**	76
PBL	59 38.56 77.63	17 22.67 22.37	76
	153	75	228

In the question about the procedures that a dentist would consider appropriate to carry out on a patient receiving IV bisphosphonates, results were favourable to the hybrid and the traditional curriculum.

Table 4.3-4 Chi-squared values for the 4.3-3 contingency table

Test	Chi-squared	Prob>ChiSq
Pearson	5.722	**0.0572**

4.3.1.3 One way analysis of graduate's enjoyment of undergraduate studies by curriculum.

A Kruskal-Wallis test failed to show any significant differences between the categories.

4.3.2 Effects of other factors

4.3.2.1 Demographic variables

Demographic variables did not seem to have any serious effects on the attitudes of the dentists to life-long learning. The presence of children in a family was found to negatively affect the amount of time a dentist would dedicate to continuing dental education (p= 0.03). This suggestion could also be supported by the finding that dentists with children did not perform as well in one of the five guideline adherence questions (p= 0.04). The fact that none of the other cross tabs gave any

significant results and the trend was not similar means that these findings cannot be considered indicative.

Table 4.3-5 Contingency analysis of number of days devoted to CDE the last year by the presence of children in the dentist's family

Count Col % Row %	None	1-5 Days	5-10 Days	10+ Days	
Children No	8 61.54 4.82	84 68.29 50.60	36 72.00 21.69	38 90.48 22.89	166
Children Yes	5 38.46 8.06	39 31.71 62.90	14 28.00 22.58	4 9.52 **6.45**	62
	13	123	50	42	228

Only 6.45% of dentists with children, dedicated more than 10 days a year on CDE.

Table 4.3-6 Chi-squared values for the 4.3-5 contingency table

Test	Chi-squared	Prob>ChiSq
Likelihood Ratio	10.139	0.0174
Pearson	8.739	0.0330

Table 4.3-7 Contingency analysis of the number of correct answers in a question regarding the usage of formocresol and alternatives by the presence or absence of children in the dentist's family.

Count Col % Row %	Wrong answer	Correct answer	
Children No	51 64.56 30.72	115 77.18 **69.28**	166
Children Yes	28 35.44 45.16	34 22.82 54.84	62
	79	149	228

In the question about which medicament the dentists would choose for pulpotomy procedures in primary molars, results were favourable to the dentists with no children.

Table 4.3-8 Chi-squared values for the 4.3-7 contingency table

Test	Chi-squared	Prob>ChiSq
Pearson	4.156	0.0415

4.3.2.2 Professional variables

4.3.2.2.1 Place of work

Several professional variables were included in the questionnaire and most of them seem to have a significant effect on the attitudes of the dentists to life-long learning.

Dentists working in rural areas potentially have a disadvantage compared to the rest of their colleagues. Accessing continuous education courses and events is likely to be more difficult and this is reflected in the results of this survey. In the contingency analysis of the place of work with the days that were devoted to continuous education over the last year, the results were much in favour of the dentists working in urban areas (p= 0.04). In almost all the analyses that were conducted regarding place of work with the rest of the variables (CDE and Questions) the trend was the similar but only once reached statistical significance (p= 0.0004).

Table 4.3-9 Contingency analysis of place of work by the number of days devoted to CDE in the last year

Count Col % Row %	City	Town	Rural	
None	5 4.24 38.46	8 9.30 61.54	0 0.00 0.00	13
1-5 Days	55 46.61 44.72	54 62.79 43.90	14 58.33 11.38	123
5-10 Days	29 24.58 58.00	15 17.44 30.00	6 25.00 12.00	50
10+ Days	29 **24.58** 69.05	9 10.47 21.43	4 **16.67** 9.52	42
	118	86	24	228

24.58% of the dentists working in urban areas reported that they have devoted more than 10 days on CDE in the last year. Only 16.67 % of the dentists working in rural areas gave the same answer.

Table 4.3-10 Chi-squared values for the 4.3-9 contingency table

Test	Chi-squared	Prob>ChiSq
Likelihood Ratio	14.418	0.0253
Pearson	12.969	0.0435

Table 4.3-11 Contingency analysis of responses on the question regarding the usage of bitewings for assessing dental caries by place of work

Count Col % Row %	Wrong answer	Correct answer	
City	27 34.18 22.88	91 61.07 **77.12**	118
Town	39 49.37 45.35	47 31.54 54.65	86
Rural	13 16.46 54.17	11 7.38 45.83	24
	79	149	228

In the question about the role of bitewing radiographs for the detection of dental caries, results were favourable to the dentists practicing in urban areas.

Table 4.3-12 Tests for 4.3-11 contingency table

Source	DF	-LogLike	RSquare (U)
Model	2	7.86132	0.0534
Error	225	139.25510	
C. Total	227	147.11642	
N	228		

Table 4.3-13 Chi-squared values for the 4.3-11 contingency table

Test	Chi-squared	Prob>ChiSq
Likelihood Ratio	15.723	0.0004
Pearson	15.602	0.0004

4.3.2.2.2 Full / Part time

Interestingly, dentists that are working full-time also dedicate more time on their CDE (p= 0.04), and enjoy their undergraduate course more than those that are working part time (p= 0.01). The results in most of the analyses were in favour of the dentists working full time and four of these results reached statistical significance.

Table 4.3-14 Contingency analysis of a dentist working full or part time by the number of days devoted to CDE in the last year.

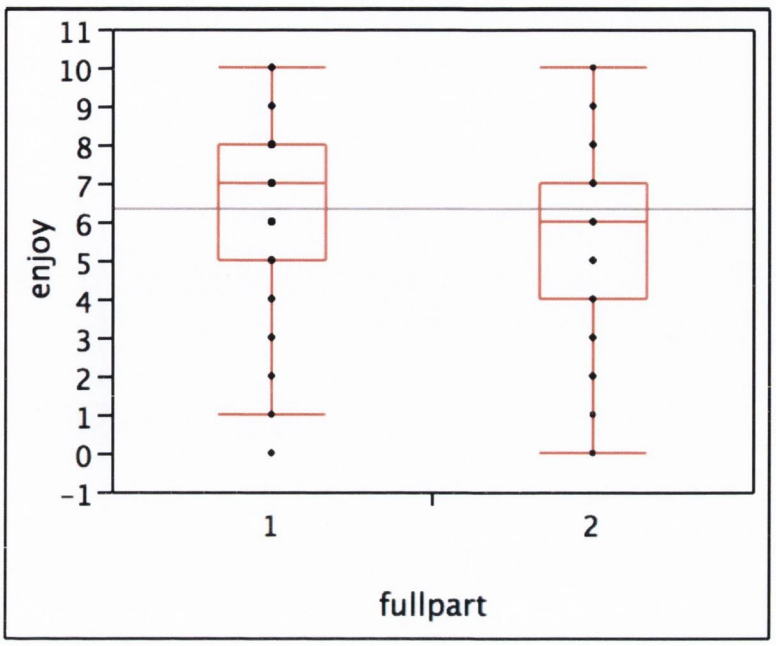
Count Col % Row %	Full	Part	
None	9 4.86 69.23	4 9.30 30.77	13
1-5 Days	95 51.35 77.24	28 65.12 22.76	123
5-10 Days	41 22.16 82.00	9 20.93 18.00	50
10+ Days	40 **21.62** 95.24	2 4.65 4.76	42
	185	43	228

Dentists that are working full time dedicated more time on their CDE.

Table 4.3-15 Chi-squared values for the 4.3-14 contingency table

Test	Chi-squared	Prob>ChiSq
Likelihood Ratio	9.561	0.0227
Pearson	7.909	0.0479

Figure 4.3-1 One way analysis of a dentist working full or part time and how much did he/she enjoyed the undergraduate studies



Dentists that are working full-time enjoyed their undergraduate course more than those that are working part-time (1 = full-time, 2 = part-time)

Table 4.3-16 Quantiles for the one way analysis in Figure 4.3-1

Level	Minimum	10%	25%	Median	75%	90%	Maximum
1	0	4	5	7	8	9	10
2	0	2	4	6	7	8.6	10

Table 4.3-17 Wilcoxon / Kruskal-Wallis tests (Rank Sums) for the one way analysis in Figure 4.3-1

Level	Count	Score Sum	Score Mean	(Mean-Mean0)/Std0
1	185	22125.0	119.595	2.450
2	43	3981.00	92.581	-2.450

Table 4.3-18 2-Sample test, normal approximation for the one way analysis in Figure 4.3-1

S	Z	Prob>|Z|
3981	-2.45043	0.0143

Table 4.3-19 1-way test, Chi-squared approximation for the one way analysis in Figure 4.3-1

Chi-squared	DF	Prob>ChiSq
6.0110	1	0.0142

4.3.2.2.3 Current position and working relation/work settings

These two variables appeared to stand out as the most important in shaping the attitude of the dentist to life-long learning. Regarding "current position", results indicated that specialists and "practice limited" groups subscribed to journals (hard copies and on-line version) more than general dental practitioners ($p = 0.0005$ and $p = 0.0004$). Additionally, dentists that were in the process of, or had already completed postgraduate studies expressed more interest in CDE activities ($p < 0.0001$). The results also demonstrated that the former group of dentists, were more up-to-date by scoring significantly better in 3 out of the 5 guideline adherence questions ($p = 0.04$, $p = 0.001$ and $p = 0.004$) and attended significantly more practical courses ($p = 0.005$). Finally, general practitioners attended markedly less conferences than the other dental groups ($p < 0.0001$).

Results from the cross-tabs between working relation with all the variables from the CDE and guideline adherence questions showed that dentists who work in a hospital environment attended significantly more conferences ($p = 0.001$), practical courses ($p = 0.01$) and dedicated more time in CDE ($p < 0.0001$) than the other groups. This group also demonstrated to be more up to date in the latest practice guidelines and protocols by achieving significantly better scores in 3 out of the 5 guideline adherence questions ($p = 0.005$, $p = 0.0005$ and $p = 0.02$)

Furthermore, these dentists declared that they had enjoyed their undergraduate studies more than the dentists working outside a hospital environment ($p=0.01$).

Table 4.3-20 Presentation of the statistically significant results for the cross-tabs between current position with all the variables from the CDE and guideline adherence questions

Cross- tab	Results	*P* value
Current position-subscription to journals Table 4-21 & 4-22	Specialists/"practice limited" group, seem to subscribe to journals more (78% to 80%) than general practitioners (35%) and Postgraduate students (38%). Postgraduate students probably have access to the journals through the University and do not have to subscribe.	0.0005
Current position- on-line access to journals Table 4-23 & 4-24	Postgraduate students had more access through the University (96%), Specialists/ "practice limited" followed (78% and 80%) with 55% of the general practitioners having on line access.	0.0004
Current position-conferences in the last 2 years Table 4-25 & 4-26	General practitioners attended markedly less conferences than the other groups.	<0.0001
Current position-Practical courses in the last 2 years Table 4-27 & 4-28	Postgraduate students attended significantly more practical courses than the other groups.	0.0058
Current position-number of days devoted to CDE the last year Table 4-29 & 4-30	Postgraduate students and specialists devoted more time to CDE	<0.0001
Current position-Medicaments chosen for pulpotomy in primary molar Table 4-31 & 4-32	Results favouring Postgraduate students, specialists and the group "other"	0.0430
Current position-bitewing radiograph interval Table 4-33 & 4-34	General practitioners scored less well than the other groups	0.0012
Current position-Antibiotic choice after tooth replantation Table 4-35 & 4-36	Postgraduate students and specialists/"practice limited" scored markedly better than the general practitioners and the group"other"	0.0048

Table 4.3-21 Contingency analysis of current position by subscription to a journal

Count Col % Row %	1	2	3	4	5	
No	109 64.12 82.58	4 22.22 3.03	16 61.54 12.12	1 20.00 0.76	2 22.22 1.52	132
Yes	61 35.88 63.54	14 77.78 14.58	10 38.46 10.42	4 80.00 4.17	7 77.78 7.29	96
	170	18	26	5	9	228

Table 4.3-22 Chi-squared values for the 4.3-21 contingency table

Test	Chi-squared	Prob>ChiSq
Likelihood Ratio	20.181	0.0005
Pearson	19.882	**0.0005**

Significant association

Table 4.3-23 Contingency analysis of current position by online access

Count Col % Row %	1	2	3	4	5	
No	77 45.29 90.59	4 22.22 4.71	1 3.85 1.18	1 20.00 1.18	2 22.22 2.35	85
Yes	93 54.71 65.03	14 77.78 9.79	25 96.15 17.48	4 80.00 2.80	7 77.78 4.90	143
	170	18	26	5	9	228

Table 4.3-24 Chi-squared values for the 4.3-23 contingency table

Test	Chi-squared	Prob>ChiSq
Likelihood Ratio	24.910	<.0001
Pearson	20.356	**0.0004**

Significant association

Table 4.3-25 Contingency analysis of current position by (how many conferences have you attended in the last two years)

Count Col % Row %	1	2	3	4	5	
0	31 18.24 96.88	0 0.00 0.00	1 3.85 3.13	0 0.00 0.00	0 0.00 0.00	32
1	30 17.65 93.75	1 5.56 3.13	0 0.00 0.00	0 0.00 0.00	1 11.11 3.13	32
2	48 28.24 90.57	0 0.00 0.00	3 11.54 5.66	0 0.00 0.00	2 22.22 3.77	53
3	26 15.29 78.79	1 5.56 3.03	5 19.23 15.15	1 20.00 3.03	0 0.00 0.00	33
4	11 6.47 45.83	4 22.22 16.67	4 15.38 16.67	2 40.00 8.33	3 33.33 12.50	24
5	5 2.94 31.25	5 27.78 31.25	5 19.23 31.25	0 0.00 0.00	1 11.11 6.25	16
5+	19 11.18 50.00	7 38.89 18.42	8 30.77 21.05	2 40.00 5.26	2 22.22 5.26	38
	170	18	26	5	9	228

Table 4.3-26 Chi-squared values for the 4.3-25 contingency table

Test	Chi-squared	Prob>ChiSq
Likelihood Ratio	81.554	<.0001
Pearson	75.682	**<.0001**

Significant association

Table 4.3-27 Contingency analysis of current position by (how many practical (Hands on) courses have you attended in the last two years

Count Col % Row %	1	2	3	4	5	
0	64 37.65 88.89	1 5.56 1.39	5 19.23 6.94	0 0.00 0.00	2 22.22 2.78	72
1	43 25.29 71.67	7 38.89 11.67	4 15.38 6.67	2 40.00 3.33	4 44.44 6.67	60
2	36 21.18 75.00	3 16.67 6.25	5 19.23 10.42	2 40.00 4.17	2 22.22 4.17	48
3	11 6.47 52.38	4 22.22 19.05	4 15.38 19.05	1 20.00 4.76	1 11.11 4.76	21
4	10 5.88 76.92	1 5.56 7.69	2 7.69 15.38	0 0.00 0.00	0 0.00 0.00	13
5	2 1.18 66.67	1 5.56 33.33	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	3
5+	4 2.35 36.36	1 5.56 9.09	6 23.08 54.55	0 0.00 0.00	0 0.00 0.00	11
	170	18	26	5	9	228

Table 4.3-28 Chi-squared values for the 4.3-27 contingency table

Test	Chi-squared	Prob>ChiSq
Likelihood Ratio	40.021	0.0213
Pearson	45.040	**0.0058**

Significant association

Table 4.3-29 Contingency analysis of current position by days devoted to continuous education in the last year

Count Col % Row %	1	2	3	4	5	
0	11 6.47 84.62	0 0.00 0.00	2 7.69 15.38	0 0.00 0.00	0 0.00 0.00	13
1-5	108 63.53 87.80	9 50.00 7.32	1 3.85 0.81	2 40.00 1.63	3 33.33 2.44	123
5-10	33 19.41 66.00	6 33.33 12.00	4 15.38 8.00	3 60.00 6.00	4 44.44 8.00	50
10+	18 10.59 42.86	3 16.67 7.14	19 73.08 45.24	0 0.00 0.00	2 22.22 4.76	42
	170	18	26	5	9	228

Table 4.3-30 Chi-squared values for the 4.3-29 contingency table

Test	**Chi-squared**	**Prob>ChiSq**
Likelihood Ratio	66.969	<.0001
Pearson	74.412	**<.0001**

Significant association

Table 4.3-31 Contingency analysis of the pulpotomy question by current position

Count Total % Col % Row %	Wrong	Correct	
1	66 28.95 83.54 38.82	104 45.61 69.80 61.18	170 74.56
2	5 2.19 6.33 27.78	13 5.70 8.72 72.22	18 7.89
3	3 1.32 3.80 11.54	23 10.09 15.44 88.46	26 11.40
4	3 1.32 3.80 60.00	2 0.88 1.34 40.00	5 2.19
5	2 0.88 2.53 22.22	7 3.07 4.70 77.78	9 3.95
	79 34.65	149 65.35	228

Table 4.3-32 Chi-squared values for the 4.3-31 contingency table

Test	Chi-squared	Prob>ChiSq
Likelihood Ratio	10.997	0.0266
Pearson	9.849	**0.0430**

Significant association

Table 4.3-33 Contingency analysis of the bitewing question by current position

Count Col % Row %	Wrong	Correct	
1	72 91.14 42.35	98 65.77 57.65	170
2	3 3.80 16.67	15 10.07 83.33	18
3	3 3.80 11.54	23 15.44 88.46	26
4	0 0.00 0.00	5 3.36 100.00	5
5	1 1.27 11.11	8 5.37 88.89	9
	79	149	228

Table 4.3-34 Chi-squared values for the 4.3-33 contingency table

Test	Chi-squared	Prob>ChiSq
Likelihood Ratio	21.459	0.0003
Pearson	18.012	0.0012

Significant association

Table 4.3-35 Contingency analysis of the replantation question by current position

Count Col % Row %	Wrong	Correct	
1	161 77.40 94.71	9 45.00 5.29	170
2	14 6.73 77.78	4 20.00 22.22	18
3	20 9.62 76.92	6 30.00 23.08	26
4	4 1.92 80.00	1 5.00 20.00	5
5	9 4.33 100.00	0 0.00 0.00	9
	208	20	228

Table 4.3-36 Chi-squared values for the 4.3-35 contingency table

Test	Chi-squared	Prob>ChiSq
Likelihood Ratio	12.963	0.0115
Pearson	14.940	**0.0048**

Significant association

Table 4.3-37 Presentation of the statistically significant results for the cross-tabs between working relation with all the variables from the CDE and guideline adherence questions

Cross- tab	Results	*P* value
Working relation-subscription to journals Table 4-38 & 4-39	Health service executives and dentists working in Hospitals scored worse possibly because they have access to the journals through the Hospital and do not have to subscribe themselves. From the other groups practice owners scored better.	Pearson 0.0064
Working relation - on-line access to journals Table 4-40 & 4-41	Dentists working in Hospitals scored significantly better than the other groups possibly because they have access through the Hospital.	Pearson <0.0001
Working relation - Conferences in the last 2 years Table 4-42 & 4-43	Dentists working in Hospitals scored significantly better and associates significantly worse than the other groups.	Pearson 0.0013
Working relation - Practical courses in the last 2 years Table 4-44 & 4-45	Dentists working in Hospitals scored significantly better and HSE dentists worse than the other groups.	Pearson 0.0195
Working relation - number of days devoted to CDE the last year Table 4-46 & 4-47	Dentists working in Hospitals scored significantly better and associates significantly worse than the other groups	Pearson <0.0001
Working relation - Medicaments chosen for pulpotomy in primary molar Table 4-48 & 4-49	Dentists working in Hospitals and " Combination" scored significantly better than the other groups	Pearson 0.0054
Working relation - bitewing radiograph interval Table 4-50 & 4-51	Dentists working in Hospitals and " Combination" scored significantly better than the other groups	Pearson 0.0005
Working relation- Antibiotic choice after tooth replantation Table 4-52 & 4-53	Dentists working in Hospitals scored significantly better than the other groups	Pearson 0.0223

Table 4.3-38 Contingency analysis of working relation by subscription to a journal

Count Col % Row %	Pr. Practice Owner	Pr. Practice Assoc.	Hospital	HSE	Comb.	Other	
No	23 42.59 17.42	55 64.71 41.67	16 61.54 12.12	26 70.27 19.70	12 57.14 9.09	0 0.00 0.00	132
Yes	31 57.41 32.29	30 35.29 31.25	10 38.46 10.42	11 29.73 11.46	9 42.86 9.38	5 100.00 5.21	96
	54	85	26	37	21	5	228

Table 4.3-39 Chi-squared values for the 4.3-38 contingency table

Test	Chi-squared	Prob>ChiSq
Likelihood Ratio	17.963	0.0030
Pearson	16.151	**0.0064**

Significant association

Table 4.3-40 Contingency analysis of working relation by online access to journal

Count Col % Row %	Pr. Practice Owner	Pr. Practice Assoc.	Hospital	HSE	Comb.	Other	
No	20 37.04 23.53	49 57.65 57.65	0 0.00 0.00	10 27.03 11.76	3 14.29 3.53	3 60.00 3.53	85
Yes	34 62.96 23.78	36 42.35 25.17	26 100.00 18.18	27 72.97 18.88	18 85.71 12.59	2 40.00 1.40	143
	54	85	26	37	21	5	228

Table 4.3-41 Chi-squared values for the 4.3-40 contingency table

Test	Chi-squared	Prob>ChiSq
Likelihood Ratio	46.994	<.0001
Pearson	38.051	**<.0001**

Significant association

Table 4.3-42 Contingency analysis of working relation by (how many conferences have you attended in the last two years?)

Count Col % Row %	Private Practice Owner	Private Practice Assoc.	Hospital	HSE	Comb.	Other	
0	8 14.81 25.00	18 21.18 56.25	1 3.85 3.13	3 8.11 9.38	2 9.52 6.25	0 0.00 0.00	32
1	8 14.81 25.00	17 20.00 53.13	1 3.85 3.13	4 10.81 12.50	1 4.76 3.13	1 20.00 3.13	32
2	13 24.07 24.53	27 31.76 50.94	3 11.54 5.66	5 13.51 9.43	5 23.81 9.43	0 0.00 0.00	53
3	6 11.11 18.18	9 10.59 27.27	5 19.23 15.15	8 21.62 24.24	3 14.29 9.09	2 40.00 6.06	33
4	5 9.26 20.83	5 5.88 20.83	3 11.54 12.50	6 16.22 25.00	5 23.81 20.83	0 0.00 0.00	24
5	2 3.70 12.50	1 1.18 6.25	6 23.08 37.50	6 16.22 37.50	1 4.76 6.25	0 0.00 0.00	16
5+	12 22.22 31.58	8 9.41 21.05	7 26.92 18.42	5 13.51 13.16	4 19.05 10.53	2 40.00 5.26	38
	54	85	26	37	21	5	228

Table 4.3-43 Chi-squared values for the 4.3-42 contingency table

Test	**Chi-squared**	**Prob>ChiSq**
Likelihood Ratio	59.031	0.0012
Pearson	58.686	**0.0013**

Significant association

Table 4.3-44 Contingency analysis of working relation by (how many practical (hands-on) courses have you attended in the last two years?)

Count Col % Row %	Pr. Practice Owner	Pr. Practice Assoc.	Hospital	HSE	Comb.	Other	
0	13 24.07 18.06	34 40.00 47.22	5 19.23 6.94	18 48.65 25.00	2 9.52 2.78	0 0.00 0.00	72
1	11 20.37 18.33	21 24.71 35.00	6 23.08 10.00	12 32.43 20.00	8 38.10 13.33	2 40.00 3.33	60
2	15 27.78 31.25	17 20.00 35.42	4 15.38 8.33	4 10.81 8.33	6 28.57 12.50	2 40.00 4.17	48
3	7 12.96 33.33	5 5.88 23.81	5 19.23 23.81	2 5.41 9.52	1 4.76 4.76	1 20.00 4.76	21
4	5 9.26 38.46	4 4.71 30.77	1 3.85 7.69	0 0.00 0.00	3 14.29 23.08	0 0.00 0.00	13
5	1 1.85 33.33	1 1.18 33.33	0 0.00 0.00	1 2.70 33.33	0 0.00 0.00	0 0.00 0.00	3
5+	2 3.70 18.18	3 3.53 27.27	5 19.23 45.45	0 0.00 0.00	1 4.76 9.09	0 0.00 0.00	11
	54	85	26	37	21	5	228

Table 4.3-45 Chi-squared values for the 4.3-44 contingency table

Test	Chi-squared	Prob>ChiSq
Likelihood Ratio	49.099	0.0154
Pearson	48.080	0.0195

Significant association

Table 4.3-46 Contingency analysis of working relation by time dedicated to continuous education the last year

Count Col % Row %	Pr. Practice Owner	Pr. Practice Assoc.	Hospital	HSE	Comb.	Other	
0	2 3.70 15.38	7 8.24 53.85	2 7.69 15.38	2 5.41 15.38	0 0.00 0.00	0 0.00 0.00	13
1-5	32 59.26 26.02	55 64.71 44.72	3 11.54 2.44	19 51.35 15.45	11 52.38 8.94	3 60.00 2.44	123
5-10	14 25.93 28.00	13 15.29 26.00	4 15.38 8.00	11 29.73 22.00	7 33.33 14.00	1 20.00 2.00	50
10+	6 11.11 14.29	10 11.76 23.81	17 65.38 40.48	5 13.51 11.90	3 14.29 7.14	1 20.00 2.38	42
	54	85	26	37	21	5	228

Table 4.3-47 Chi-squared values for the 4.3-46 contingency table

Test	Chi-squared	Prob>ChiSq
Likelihood Ratio	47.712	<.0001
Pearson	54.182	**<.0001**

Significant association

Table 4.3-48 Contingency analysis of the pulpotomy question by working relationship

Count Col % Row %	Wrong	Correct	
1	17 21.52 31.48	37 24.83 68.52	54
2	32 40.51 37.65	53 35.57 62.35	85
3	4 5.06 15.38	22 14.77 84.62	26
4	21 26.58 56.76	16 10.74 43.24	37
5	5 6.33 23.81	16 10.74 76.19	21
6	0 0.00 0.00	5 3.36 100.00	5
	79	149	228

Table 4.3-49 Chi-squared values for the 4.3-48 contingency table

Test	Chi-squared	Prob>ChiSq
Likelihood Ratio	18.374	0.0025
Pearson	16.565	**0.0054**

Significant association

Table 4.3-50 Contingency analysis of the bitewing question by working relationship

Count Col % Row %	Wrong	Correct	
1	18 22.78 33.33	36 24.16 66.67	54
2	42 53.16 49.41	43 28.86 50.59	85
3	1 1.27 3.85	25 16.78 96.15	26
4	11 13.92 29.73	26 17.45 70.27	37
5	7 8.86 33.33	14 9.40 66.67	21
6	0 0.00 0.00	5 3.36 100.00	5
	79	149	228

Table 4.3-51 Chi-squared values for the 4.3-50 contingency table

Test	**Chi-squared**	**Prob>ChiSq**
Likelihood Ratio	27.422	<.0001
Pearson	22.179	**0.0005**

Significant association

Table 4.3-52 Contingency analysis of the replantation question by working relationship

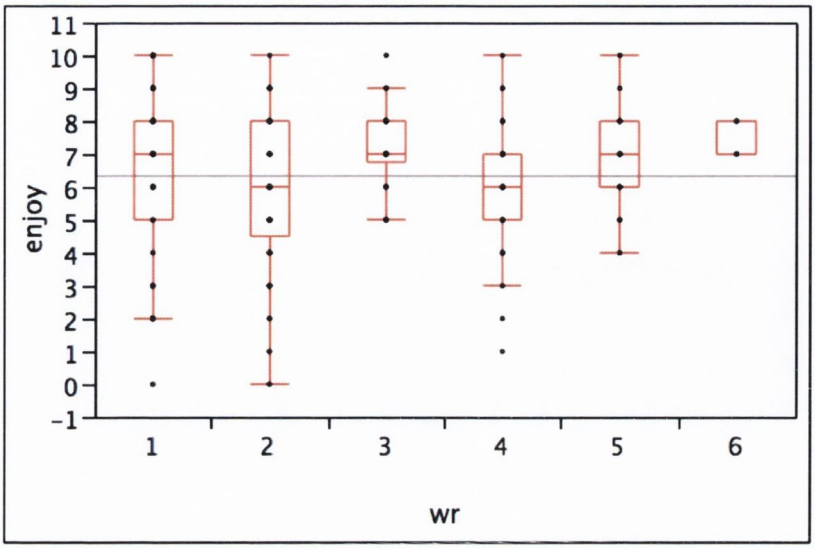
Count Col % Row %	Wrong	Correct	
1	48 23.08 88.89	6 30.00 11.11	54
2	77 37.02 90.59	8 40.00 9.41	85
3	20 9.62 76.92	6 30.00 23.08	26
4	37 17.79 100.00	0 0.00 0.00	37
5	21 10.10 100.00	0 0.00 0.00	21
6	5 2.40 100.00	0 0.00 0.00	5
	208	20	228

Table 4.3-53 Chi-squared values for the 4.3-52 contingency table

Test	**Chi-squared**	**Prob>ChiSq**
Likelihood Ratio	16.738	0.0050
Pearson	13.119	**0.0223**

Significant association

Figure 4.3-2 One way analysis of a dentist's working relation and how much he/she enjoyed the undergraduate studies



Dentists that are working in a hospital environment enjoyed their undergraduate course more than those that are working in other settings. (1 = Own practice, 2 = Associate, 3 = Hospital, 4 = Health services executive, 5 = Combination, 6 = Other)

Table 4.3-54 Quantiles for the one way analysis in Figure 4.3-2

Level	Minimum	10%	25%	Median	75%	90%	Maximum
1	0	2	5	7	8	10	10
2	0	3	4.5	6	8	8	10
3	**5**	**5**	**6.75**	**7**	**8**	**9**	**10**
4	1	3.8	5	6	7	8.2	10
5	4	5	6	7	8	8.8	10
6	7	7	7	8	8	8	8

Table 4.3-55 Wilcoxon / Kruskal-Wallis tests (Rank Sums) for the one way analysis in Figure 4.3-2

Level	Count	Score Sum	Score Mean	(Mean-Mean0)/Std0
1	54	6715.00	124.352	1.272
2	85	8474.50	99.700	-2.646
3	**26**	**3657.00**	**140.654**	**2.175**
4	37	3746.50	101.257	-1.351
5	21	2719.00	129.476	1.105
6	5	794.000	158.800	1.536

Table 4.3-56 1-way test, Chi-squared approximation for the one way analysis in Figure 4.3-2

Chi-squared	DF	Prob>ChiSq
14.7927	5	**0.0113**

4.4 Discussion

The principal aims of the questionnaire were as follows:

1) To assess the attitude of the dentist towards life-long learning.

2) To collect important demographic and professional data.

Assessing life-long learning attitudes is not an easy task, as very few structured attempts exist in the literature (Harvey *et al.* 2003, Peters *et al.* 2000, Tolnai 1991, Shin *et al.* 1993). As with all attitudes, assessing the attitude itself usually means evaluating its most common expressions. My objective was to evaluate the dentists´ attitude towards life-long learning through a combination of indicators. One part of the questionnaire aimed to provide insight regarding the use, frequency and nature of the resources the dentist has used in a defined time period for professional development. It is reasonable to expect that a dentist with a positive attitude to life-long learning would be more inclined to use several educational resources and be more pro-active during this period. The other part involved specific guidelines issued or adopted by formal professional bodies addressing different aspects of clinical practice. These guidelines are very specific and have a "life expectancy" of 2-3 years before they get reviewed and replaced by new ones. Although the specific nature of these guidelines might mean that in some occasions the nature of the practice (specialist, general practitioner etc) might determine their relevance for each individual, it is reasonable to assume that in a large sample of general dentists, knowledge of the latest guidelines is indicative of up-to-date clinical practice. This particular aspect of the study might favour the last two graduating cohorts, which graduated under PBL, as they were most likely taught under the latest guidelines.

Studies comparing whole curricula and cohorts of graduates are often criticised for having limited control over the changes that normally take place over a period of years (Schmidt 1998). For example, graduates of the year 2004 may have had many differences in their education

compared with those from 2001, who also graduated from a PBL curriculum. This is very true when it comes to the content of the education and the factual knowledge, yet as much as it concerns the attitudes towards life-long learning, the diversity is not extensive. On the contrary, advocates of PBL have often claimed that the method itself is what enhances life-long learning attitudes among graduates, even if the discipline related learning objectives are the same as to those of didactic teaching. In other words, it is suggested that it is not "what you learn", but "how you learn" that could determine attitudes towards life-long learning.

In this study, there have certainly been several changes within the 12 cohorts of graduates in the content, discipline related knowledge and skills in the curriculum. However, in as far as the attitudes to life-long learning are concerned; no particular targeted intervention was introduced in any of the years, other than the change of the curriculum methodology itself. Evidently it is also reasonable to expect that the advances of learning technologies and a wider implementation of continuous education, distance learning and e-learning possibilities would favour life-long learning attitudes among the graduates of the latest cohorts, in this case the graduates of the PBL curricula (Shitteck *et al.* 2001, Mattheos *et al.* 2001).

Interestingly, this study found no evidence that the attitude of the dentist towards life-long learning is influenced by the undergraduate curriculum at the Dublin Dental School & Hospital. Professional and demographic variables seem to have a more profound effect on this attitude. Response bias could be an explanation for this study's inability to detect any differences. The response rate, although not particularly high at 60%, it was uniform across the 3 groups.

Although there are limitations in drawing conclusions from this survey, we could make a few suggestions based on our findings. Postgraduate studies seem to have a positive effect on the attitude of the dentists towards life-long learning. This finding should not come as a surprise

since professionals that seek to enrol to such a course are usually those that excelled in their undergraduate studies. Additionally, the structure of most postgraduate courses is such that it promotes critical thinking and self-directed learning. It is also embarked on during a period of the dentist's life when he/she is already comfortable with Dentistry as a science and can concentrate on aspects of it that he / she finds more interesting and stimulating.

It is thought that interaction with colleagues from different disciplines is another way of stimulating learning. If this is true, it may explain why dentists that work in a hospital environment as opposed to those that work in a practice on their own, have a more positive attitude towards life-long learning. Everyday discussions with their colleagues and the exchange of information can only be helpful and stimulating.

Although there is limited evidence that PBL is effective in continuing education, it is somehow ironic that a typical conference or CDE course includes a series of didactic non self-directed lectures delivered by experts (Smits *et al.* 2002). Taking into account that this is inherently different to what PBL is trying to teach and that the majority of the dentists think that conferences and courses are the best way of keeping up to date, one might wonder if this strategy is educationally flawed (Nash 1994). The fact that personal study and working part-time in an educational institution was not selected by the majority of the dentists as a good way of keeping up-to-date is equally worrying.

It seems inevitable that whatever effects the undergraduate curriculum might have on the attitude of the dentists towards life-long learning, this will eventually be overpowered by the effects of life itself. If a dentist opens a practice in a rural area, has a loan and an expanding family, chances are he/she will spend less time in CDE than somebody that has easier access to CDE events and less responsibilities. All these factors are eventually bound to be more influential than the undergraduate curriculum itself. So does the undergraduate curriculum matter in the long run? I would agree with Mattheos *et al.* (2010) in

saying that "its role in stimulating the development of a life-long learning attitude should not be underestimated". To positively answer this question though, further research is needed. The effect of the curriculum on life-long learning can perhaps be better evaluated when active, well structured, easily accessible and competency oriented CDE programs are in place. There are plans for improvements in the way CDE is delivered in Ireland which are going to take effect in the near future. A follow up study in a number of years could provide us with valuable information.

4.5 Conclusions

Undergraduate curriculum type was found to have very little or no effect on the graduate's attitude toward life-long learning or confidence in their ability to practice dentistry. However, these attitudes did appear to be influenced by certain family, demographic and professional characteristics. Further research is needed.

More results and tables from this study can be seen in Appendix 8.6.

The results of this study were presented in the general session of IADR which took place in Miami, FL. (1-4 April 2009).

4.6 Publication details

This study was accepted for publication in the European Journal of Dental Education on the 18th June 2009. (Appendix 8.7)

4.7 Life-long learning feedback interview

Continuing Dental Education (CDE) is only one part of the learning experiences in which a practicing dentist would need to engage in order to promote his professional development. It is a structured process designed to enhance all dentists' professional competency. Continuing Professional Development goes beyond that, since it is focused on the individual practitioner. (www.farmasi.uio.no)

Historically, many Irish dentists have been complacent regarding Continuing Professional Development (CPD) because it was not compulsory, however changes are in motion. The current situation in Ireland relies on an ethical obligation to undergo CPD rather than a mandatory requirement. The Irish Dental Council recommends that "one should complete and keep records of at least 50 hours of CPD per year, at least 20 of which should be verifiable. While the amount of CPD hours completed may vary from year to year, it is expected that dentists will complete at least 250 hours of CPD over 5 years, of which a minimum of 100 hours should be verifiable". This situation applies to all dentists including those working part time or retired dentists who wish to remain on the Register. The Dental Council does not require submission of documentary evidence until the scheme becomes mandatory. Unless legislative changes are made, CPD cannot be made a mandatory requirement for ongoing registration in Ireland.

When questioned about compulsory CPD, the interviewees were universally in favour, with many suggesting it was "about time". However, confusion still exists and many of the dentists interviewed were awaiting clarity of the exact CPD requirements in Ireland and how it is to be enforced. Some interviewees highlighted the need for one professional body to take responsibility for both implementation and regulation of the CPD points. One specialist dentist recommended that required CPD points be made known at the beginning of the year so people can plan ahead and minimise disruption to staff and patients. Many remarked that CPD courses are primarily attended by the same cohort of dentists and expressed wonder about whether other dentists do in fact fulfil CPD. Compulsory CPD was thought by most interviewees to address this concern.

While most interviewees could not see any disadvantages of compulsory CPD, those that did foresee problems reported concern that CPD may impose a potential financial burden on those working part-time. One dentist working part-time in a rural area suggested that a

further disadvantage of compulsory CPD is that one might be inclined to attend the most convenient CPD event just to get credits, even if it is not ones preferred topic. Given that having an interest in a particular area was a major influencing factor for this dentist to participate in CPD, this could negatively influence her attitude towards life-long learning.

When questioned about what motivates a person to participate in CPD activities, almost all of those interviewed stated the fact that CPD was compulsory would be the major incentive. When asked what CPD meant to them, the majority of interviewees felt it was "a way of keeping up-to-date". Many reported that the need for a dentist to keep up-to-date is now more important than ever due to increased public knowledge and awareness. Aside from this, one specialist working full-time, in private practice in an urban area suggested his primary motivation to attend CPD activities was to "acquire referrals". While general dentists felt attending lectures and conferences were the best ways to keep up-to-date, the specialists interviewed considered journal subscriptions more advantageous.

Time pressure was cited as a major barrier to CPD reported by most interviewees. When questioned regarding a CPD event, which was planned but ultimately not attended, the main reasons cited were family commitments, inability to get time off work and financial restrictions. Dentists working in private practice and those employed by the Health Service Executive pointed out that the current economic climate has made it increasingly difficult to avail of CPD opportunities. On the other hand, interviewees that work in a hospital environment commented that their institution was very supportive in assisting their attendance at conferences. These responses are in agreement with the results of the questionnaire which suggested that those dentists who work within a hospital environment attended significantly more conferences and dedicated more time to CPD.

One dentist working full-time in a rural area with a young family suggested that financial barriers could be eased by professional

organisations running more cost effective CPD opportunities and holding courses at weekends. As family restrictions influence one's ability to attend weekend CPD activities, it was suggested that courses should include facilities for non-dental family members. As well as financial barriers to participating in CPD, one general dentist working full-time in private practice reported that physical tiredness hugely influenced her motivation to commit to CPD. She complained that many CPD lectures were scheduled on a Thursday night, by which time one is tired after a busy week. Another general dentist with similar characteristics but working for the National Health Service felt that working full time resulted in less CPD participation due to difficulties taking time off. A single, general dentist working in private practice full-time reported that the opportunity to combine a foreign holiday with a CPD activity greatly influenced her decision to attend certain events. In contrast, another dentist with a young family, working part-time in a rural area believed that she would have difficulty attending CPD activities at all due to family commitments, and would be more likely to attend any course for convenience sake, just to gather required compulsory CPD points. This dentist went on to suggest that there should be a reduced CPD requirement for parents with young children. Results of the questionnaire also indicated that the presence of children within a family was found to negatively affect the amount of time a dentist would dedicate to CPD compared to single individuals.

Given the choice, practical hand-on CPD courses are preferred by most dentists. However, increased availability of CPD via on-line resources was recommended by many of the interviewees but especially by those working part-time and limited by family commitments. Any on-line activity requires the participant to have a certain level of computer skill, and some of the older dentists interviewed felt disadvantaged in this respect. On the other hand, some of the specialists interviewed questioned the quality of on-line courses. Other interviewees echoed this concern that following the introduction of compulsory CPD there may be many non-verifiable courses of poor quality, unless properly regulated. For the same reasons, some interviewees commented that

they could see little benefit of compulsory, non-verifiable CPD, which in Ireland is proposed to comprise the majority of the annually required CPD hours.

Some of the dentists interviewed mentioned that their attitude toward life-long learning was influenced by the realisation of how quickly one's knowledge is outdated, due to the constantly changing nature of dentistry. Most interviewees did not feel that their supervisors had influenced their attitude towards life-long learning. However, those that felt otherwise, suggested that supervisors who showed an interest while teaching were more inspiring. Such supervisors had assisted in stimulating a student's passion for the job, which reportedly influenced future attitude toward life-long learning in one dentist who completed a 'hybrid' undergraduate curriculum. Another dentist who completed a traditional curriculum felt his undergraduate teaching had been presented as "the correct way to do it", with little emphasis on an evidence base. This may suggest that the traditional curriculum while it taught the basics well, did not inspire a critical approach to learning. In contrast, another dentist who completed a fully PBL undergraduate curriculum felt she "remembered more" because PBL makes one more responsible for one's own learning, and this in turn greatly impacted on her attitude toward life-long learning. While these opinions are noteworthy, the results of the previous questionnaire did not find any correlation between the type of undergraduate curriculum and attitude toward life-long learning.

Postgraduate study places a huge emphasis on developing an enquiring mind and adopting a critical approach to appraising evidence. For this reason, all those interviewed who had completed postgraduate study felt it had hugely influenced their attitude toward life-long learning. All of the specialists commented that in hindsight, they had little appreciation of what life-long learning entailed prior to completion of a structured postgraduate programme. A further specialist concurred that postgraduate training changes your outlook toward life-long learning and as a specialist you feel obliged to continue with CPD.

Finally, 5 interviewees admitted that they had not returned the original questionnaire. The main reason given for not doing so by all of them was lack of time. Three of them complained that they receive so many questionnaires from universities, societies and companies that it becomes a "full time job" trying to answer them all. The same three said that they used to reply to most questionnaires but nowadays they would only respond if they knew the researcher personally or if they were given an incentive such as a free subscription to a journal or lecture.

The responses of the interviews were generally in agreement with the overall results of the previous questionnaire. The data from the feedback interviews did however provide useful additional information. The opinions and suggestions offered by the cohort interviewed offer additional insight into what motivates the intricate question of life-long learning and how current changes in CDE are being received by dentists with different demographics.

Universities, professional societies and associations need to share the responsibility of designing good quality and easily accessible CDE courses for the practicing dentists. The introduction of awareness of the value and the need for a lifelong learning attitude at the undergraduate level will never count for much if it is not followed by such an organized approach towards CPD after graduation.

5 Can evaluation of a dental procedure at the outset of learning predict later performance at the preclinical level?

5.1 Introduction

In most European countries, dental schools are using the intellectual capacity of the applicant in the form of secondary school grade point average in order to predict the students' future success (Gillet *et al.* 2002). In the United States, Dental Admission Test (DAT) was introduced in the 1950's as a supplement to the students' pre-dental cumulative grade point and science grade point average in order to assess a candidate's academic and perceptual motor abilities. For this purpose a chalk carving test was introduced as a subtest in the DAT. In 1973 this subtest was replaced by a paper and pencil measure of perceptual abilities test (PAT) (Coy *et al.* 2003). Canadian admission tests are very similar to those used in the US but they include a formalized carving test due to voiced concerns about relying solely on a paper and pencil measure (Coy *et al.* 2003). There are numerous studies in the dental literature examining the innate abilities or aptitudes of dental students and their effect on future clinical performance. Much of this research has focused on evaluating admission criteria to a dental program and the results have been inconclusive (Oudshoorn 2003, Gansky *et al.* 2004, Park *et al.* 2006, Lundergan *et al.* 2007).

According to Gray and Deem (2002) such research has been limited because of the lack of expert knowledge on the components of psychomotor ability and the different ability of determinants in predicting complex skill acquisitions. The authors propose that sound research regarding the relevant performance of students is impossible unless there is a clear understanding of the demands of the task complexity, the degree of task practice and the consistency of information-processing demands. They concluded that cognitive tests like PAT are

useful in predicting success in the preclinical years of the dental school but it was not useful in predicting clinical performance. They suggested further investigation relative to non-cognitive predictors, such as motivation, past experiences and psychomotor ability (Gray *et al.* 2002).

It has been suggested that that there is a relationship between manual, written and intellectual aptitudes but again results have been inconclusive (Gray *et al.* 2002). Because of the very strict admissions requirements, dental students can be universally considered as a select group and prediction of future results could be of little importance (Gray *et al.* 2002) . Furthermore recent studies have shown that aptitude tests may not be applicable as predictors of future student performance because practice and experience appear to significantly improve the manual ability of students and by enlarge avert the impact of innate abilities over time (Phipps *et al.* 1968, Giuliani *et al.* 2007).

The aim of this study was to determine if evaluation of a dental procedure at the beginning of dental training can be a predictor for future performance at the pre-clinical level and to observe if conventional training significantly improved pre-clinical performance.

5.2 Materials and methods

Ethical approval was attained from the faculty research ethics group faculty of health sciences, Trinity College Dublin. Fourteen days before the first lecture and demonstration, an information leaflet was circulated to the students (Appendix 8.8). Each student was given a consent form which was asking them if they want to participate or not in the study (Appendix 8.9). An entire class of thirty eight (38) second year dental students agreed to take part in the study. Of these, 10 of them failed to complete either the first or the second step of this exercise and were subsequently excluded (N=28). All students were given an introductory lecture and a demonstration on the design and instrumentation of conventional class I cavity preparation, for an amalgam restoration. Each student was given a plastic typodont lower left first permanent

molar and they were asked to prepare a class I cavity preparation. All students were additionally provided with a millimetre graduated periodontal probe, a mouth mirror and a sharp straight probe. All preparations were completed with the same ISO standard pear shaped tungsten carbide bur (330), used in a turbine hand-piece at ultrahigh speeds and with continual water spray. All teeth were coded anonymously. Conventional training took place twice a week for twelve weeks following which the same test was repeated (Quinn *et al.* 2003 a,b)

Two independent scorers from different institutions were used. The coded teeth were submitted to the examiners and this was the sole submission identifier. These two experienced and previously calibrated scorers were not informed of the nature of the project but were supplied with the "ideal" cavity dimensions and illustrations of the desired cavity shape on the lower left first molar (Wanzel *et al.* 2003, Summitt *et al.* 2001). The examiners were requested to provide a score of 1-5 for the following aspects of the cavity design: outline form, retention form, depth, smoothness, cavosurface angulation (Wanzel *et al.* 2003) and 'cavity margin index (Kidd *et al.* 1996). The criteria for cavity evaluations were based on 'best practice' information (Summitt *et al.* 2001, Kidd *et al.* 1996). These criteria, although subjective, were intended to be as clear-cut as possible. All data were recorded on a Microsoft® Excel 2007 (Microsoft Inc., Redmond, WA, USA). Statistical analysis was carried out using SPSS version 14.0 for Windows® statistical software (SPSS Inc. Chicago Illinois, USA).

5.3 Results

An initial exploratory regression analysis with the before and after scores as the dependent variables and examiner and student effect as the independent variables showed that the difference in scoring between examiners was not statistically significant (p=0.37) (Figure 5.3-1 and Table 5.3-1)

Figure 5.3-1 Leverage plot. Difference in scoring between examiners.

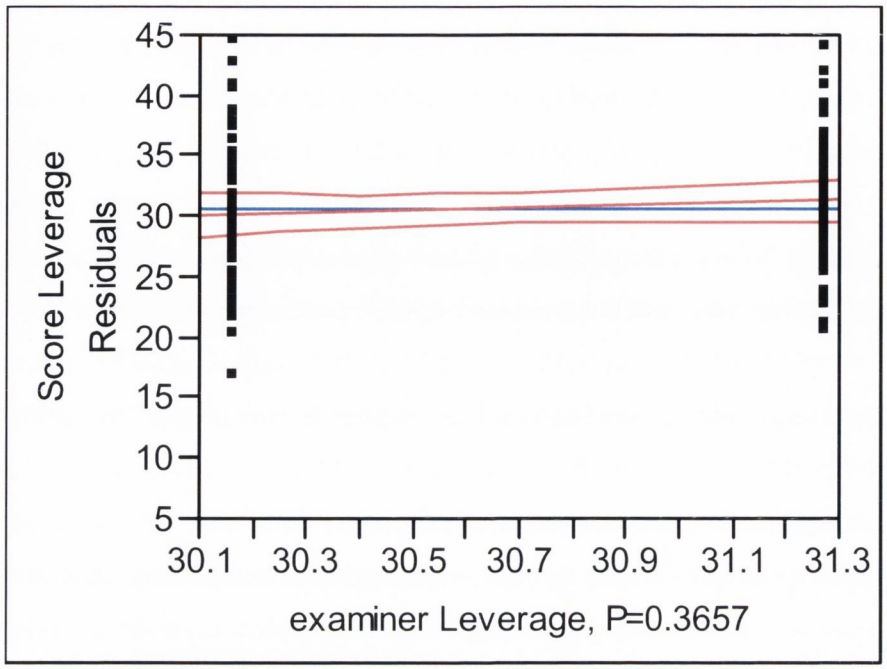


Table 5.3-1 Least squares means table

Level	Least Sq Mean		Std Error	Mean
1	30.160714		0.86064724	30.1607
2	31.267857		0.86064724	31.2679

On return of scores, the code was broken and data was analysed. Normality was confirmed using the Komolgrorov and Smirnov test (p>0.05). It is worth noting the decrease in standard deviation after training compared to it before training (6.42 from 9.50), which indicates a convergence in performance. (Figure 5.3-2, 5.3-3 and Tables 5.3-2, 5.3-3, 5.3-4, 5.3-5)

Figure 5.3-2 Distribution of scores before conventional training

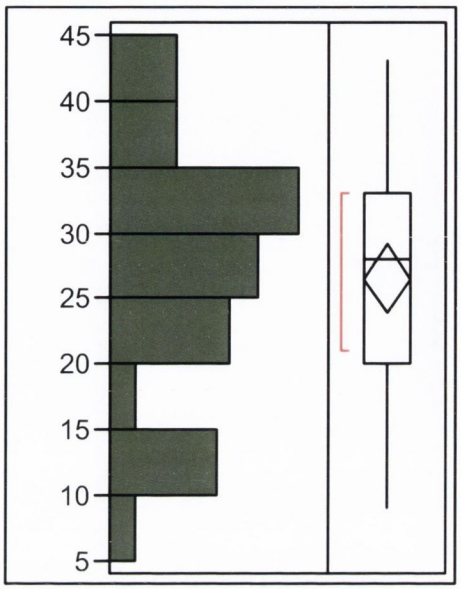


Table 5.3-2 Quantiles before conventional training

100.0%	maximum	43.000
99.5%		43.000
97.5%		43.000
90.0%		39.300
75.0%	quartile	33.000
50.0%	median	28.000
25.0%	quartile	20.000
10.0%		11.700
2.5%		9.000
0.5%		9.000
0.0%	minimum	9.000

Table 5.3-3 Moments before conventional training

Mean	26.517857
Std Dev	9.504049
Std Err Mean	1.270032
upper 95% Mean	29.063058
lower 95% Mean	23.972656
N	56

Figure 5.3-3 Distribution of scores after conventional training

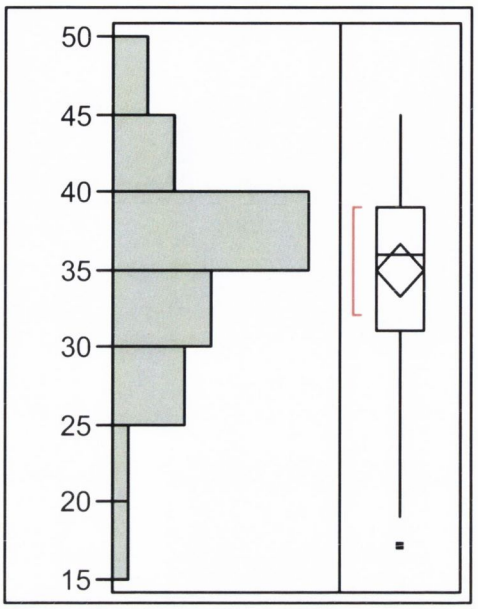


Table 5.3-4 Quantiles after conventional training

100.0%	maximum	45.000
99.5%		45.000
97.5%		45.000
90.0%		42.300
75.0%	quartile	39.000
50.0%	median	36.000
25.0%	quartile	31.000
10.0%		27.400
2.5%		17.850
0.5%		17.000
0.0%	minimum	17.000

Table 5.3-5 Moments after conventional training

Mean	34.910714
Std Dev	6.4251687
Std Err Mean	0.8585993
upper 95% Mean	36.631386
lower 95% Mean	33.190043
N	56

A paired t-test was used to compare the difference between the means of before and after scores (+ 8.39). At $p<0.0001$ the difference was highly significant (Table 5.3-6).

Table 5.3-6 Paired t-test to compare the difference between the means of before and after scores

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair 1	Before - after	-8.39	9.11478	1.218	-10.8	-5.95	-6.89	55	.000

The correlation coefficient (Pearson's linear correlation) between scores before and scores after training was r = 0.4 which indicates a positive relationship (p = 0.002), (Figure 5.3-4 and Table 5.3-7).

Figure 5.3-4 The correlation coefficient (Pearson's linear correlation) between scores before and scores after training

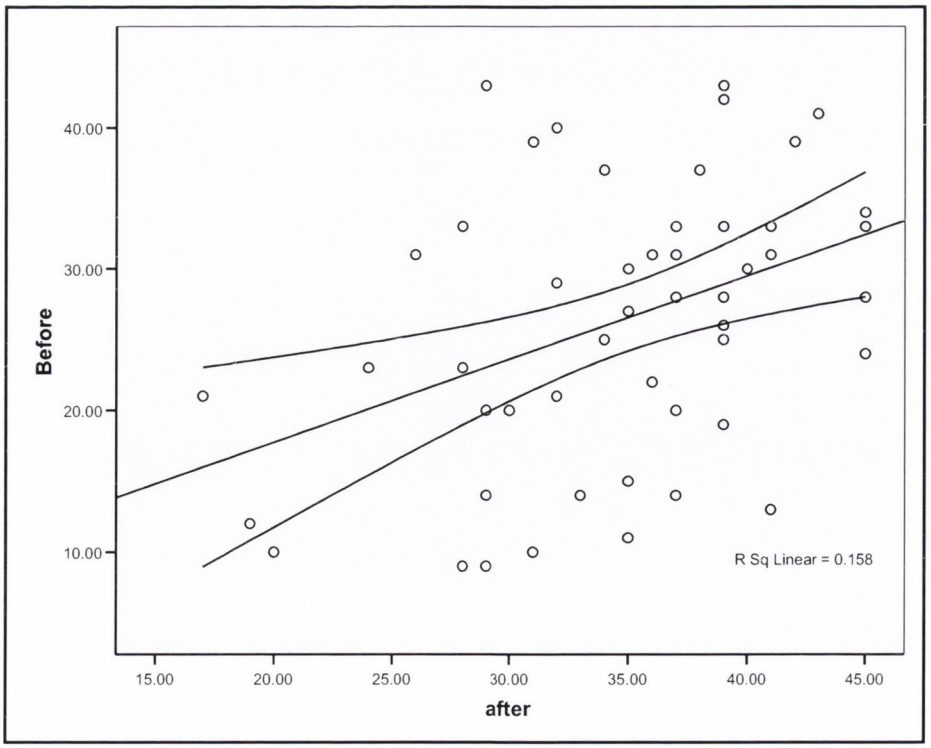


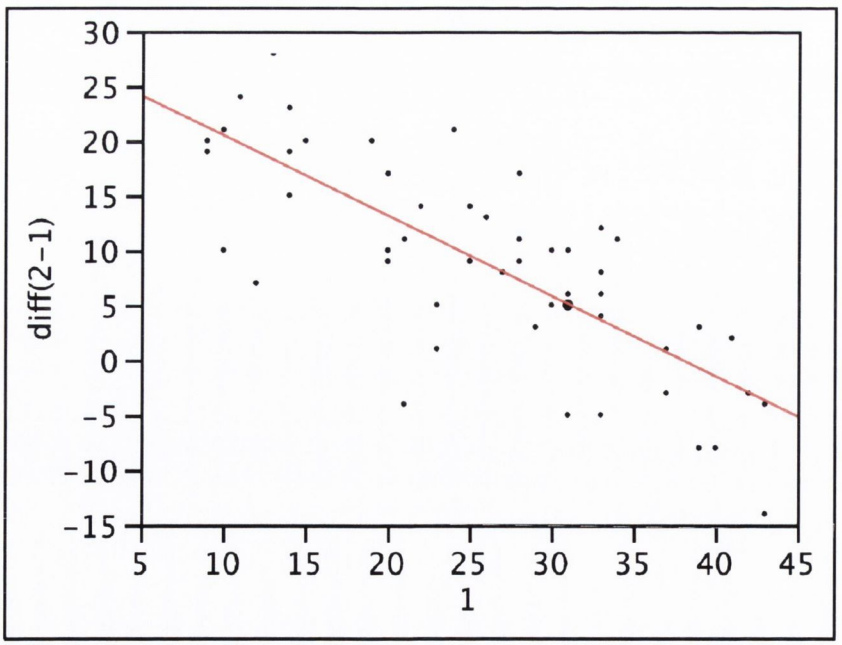
Table 5.3-7 Correlations

		Before	after
Before	Pearson Correlation	1	.397(**)
	Sig. (2-tailed)		.002
	N	56	56
After	Pearson Correlation	.397(**)	1
	Sig. (2-tailed)	.002	
	N	56	56

** Correlation is significant at the 0.01 level (2-tailed).

By using a form of regression to the mean, we observed that for low initial scores the change is high (much improved after the training period) but for high initial scores there was little or no improvement (Figure 5.3-5). It is important though to always remember the ceiling effect due to the grading systems, which usually limits the capability of the highest performing students.

Figure 5.3-5 Plot of the change [score after (2) – score before (1)] versus score before (1). Note the pronounced negative slope. So, for low initial scores – the change is high (much improved after training period) but for high initial scores there is little improvement.



5.4 Discussion

Results from this study showed that there was a significant improvement in the performance of the students after the end of conventional training. This is in agreement with the results of a number of other studies (Giuliani *et al.* 2007, Wanzel *et al.* 2003, Luck *et al.* 2004, de Andes *et al.* 2004). It seems that there is significant evidence that studying dentistry leads to an improvement in manual skills compared to control students from other disciplines that are not manually challenged from the beginning of their studies (Luck *et al.* 2004). A study by Coy and co-workers investigated the effectiveness of a PAT test in predicting future clinical performance (Coy *et al.* 2003). Results indicated a gender bias favouring male applicants. However, once admitted to the dental school, male and female student demonstrated similar development of technical skills (Coy *et al.* 2003). Students do not have the same starting point and this could explain why there was a moderate association between the results before and after conventional training (Fig 5.3-4). A number of studies commented on the diversity found between new dental students regarding their background and previous experiences and how these might have influenced their manual ability (Gillet *et al.* 2002, Giuliani *et al.* 2007). However, the overwhelming majority of the students reach a similar academic and clinical competency prior to graduation.

A number of studies managed to correlate perceptual ability tests with pre-clinical performance but no such correlation was evident when clinical performance was assessed (Phipps *et al.* 1968, Gray and Deem 2002). According to Gray and co-workers, these results could be explained by the Ackerman's theory of ability determinants of skilled performance (Ackerman 1988, Ackerman 1992, Gray *et al.* 2002). In order to acquire complex skills, like dentistry, one has to go through three phases. The first is the cognitive phase where the learner has to understand the theory and formulate strategies for task goals. Dentistry is a complex task that regularly requires the processing of new

information, which in turn constantly challenges certain intellectual abilities. The second or associative phase has to do with the speed and efficiency at which a task can be accomplished by strengthening the associations between stimuli and responses (perceptual speed abilities). Finally, the autonomous phase of skill acquisition is associated with demands on psychomotor abilities (Gray *et al.* 2002). It seems that to date, most studies concerning the prediction of individual differences in skill acquisition used tests that focused on consistent tasks (Tremometer test, Johnson O'Connor tweezer dexterity test and many more) (Lundergan *et al.* 2007, Luck *et al.* 2004), although many tasks in the work environment include substantial, inconsistent information-processing demands (Gray and Deem 2002, Gray *et al.* 2002). Due to the complexity of the processes to acquire the skills necessary for practicing dentistry, lack of specific tests, that use both cognitive and non-cognitive predictors, could explain why we are failing to predict future results (Gray and Deem 2002, Gray *et al.* 2002). Another explanation could simply be that the majority of students can master the manual dexterity skills needed for dentistry and as students progress in their training over the years their performance converges (Gansky *et al.* 2004).

Chaiken *et al.* (2000) designed a study with the aim of investigating the organization and the components of psychomotor abilities by administering a number of cognitive and psychomotor tasks to 161 high school graduates. They examined the hypothesis of a general psychomotor factor made up of a set of independent sub-factors. They also investigated the possibility of a relationship between psychomotor abilities and cognitive, temporal and processing speed abilities. Furthermore, since the participants improved with practice, the investigators tried to identify the factors responsible for that improvement. Confirmatory factor analysis identified two psychomotor factors: Firstly; a general factor associated with all psychomotor tests and correlated to two cognitive factors; most significantly to the general working memory capacity ($r = 0.67$) and to a lesser extend to the ability to keep track of time ($r = 0.32$). Secondly, an orthogonal psychomotor

learning factor, independent from the general psychomotor ability and responsible for the improvement after practice, was found to be related to processing speed (r = 0.49). Unfortunately, it was not possible to identify the psychological mechanism of these observations. The results of this study seem to support the opinion that cognitively able students also have the tendency to do well on psychomotor tasks (Chaiken *et al.* 2000).

When reading these studies it must be remembered that, in most of them, the ability determinants are not clearly defined and care should be exercised in extrapolating the results from one country to another due to different educational systems. In some studies, the tests taken by the participants had an effect on an extremely important evaluation and in others, the students knew that it was just a research project (Giuliani *et al.* 2007). Participation bias should be taken into consideration as a relatively equal number of participants are needed to take the tests at different time points and for the duration of a course. Since the majority of the tests for these studies were not mandatory, we can easily understand that achieving this, is very difficult and sometimes impossible. As a result, any attempt to correlate scores before admission with scores during the clinical years, usually has a very limited value. Finally, scoring at the preclinical level is usually anonymous, which is not the case at the clinical level. Add the patient factor and the different grading systems into the equation and then we can get a better idea of why it is so difficult to reliably correlate results from different time points during a long course like dentistry (Gray *et al.* 2002). In this study, it could be argued that it is almost inevitable that a bias is at hand both with respect to lecturer performance and the approach taken at demonstration when the task of choice is performed after the lecture and the demonstration respectively.

A potential direction for future research would be to examine prospective dental students with specialized psychomotor and cognitive tests and have a long-term follow up of the successful applicants. Their performance should be followed up over the academic years by these

specialized tests and not by standard tests used for evaluation of their clinical and academic performance. This way, the results will be comparable and it may be possible to identify the cognitive abilities responsible for assisting or hindering the psychomotor performance of dental students.

According to some, general psychomotor ability cannot be but a reflection of the general cognitive ability (Al Tahawi 1995). In other words, good students are well capable of developing good quality clinical skills over time. Students that succeed academically are hard working, determined, organized and inventive. In order to progress clinically, these same qualities are necessary and one would assume that there is bound to be some overlap between the skills required for academic success and those that are required for clinical competency (Park *et al.* 2006). Because of the very strict admission requirements, dental students can be universally considered as a select group and prediction of future results could be of little importance (Gray *et al.* 2002). According to Gulliani and co workers "manual ability is not simply practical and mechanical in essence but strongly correlates to the mental capacities to plan, organise, analyse and verify" (Giuliani *et al.* 2007).

It appears that there is no strong evidence that predictive tests have any practical predictive capacity and it would therefore be inappropriate to discriminate between students on the basis of these scores. There will always be a very small percentage of students that turn out to be unmotivated or unsuitable. These students can best be identified by the faculty members that have spent a significant amount of time with them during their pre-clinical training and are aware of their shortcomings (Gansky *et al.* 2004)

5.5 Conclusions

From the present study it could be concluded that conventional pre clinical training results in a significant improvement in the manual skills of the dental students and that the dental procedure used has only a limited predictive value for later performance at the preclinical level. Additionally, students who scored low initially markedly improved by the end of training but those that scored high initially improved little or not at all.

5.6 Publication details

This study was accepted for publication in the European Journal of Dental Education on the 27th of April 2010. (Appendix 8.10)

6 Clinical teaching in restorative dentistry and the variation between students' and supervisors' perceptions of its effectiveness

6.1 Introduction

In most dental schools, students are taught by clinicians with little or no experience in teaching. However, clinical expertise alone is not enough for good teaching since students are usually laden with all sorts of anxieties, needs and problems that interfere with learning (Bradford 1958). According to Ullian (1986), 'clinical teachers should realise that they assume four principal roles in their interactions with the students: Physician, Teacher, Supervisor, and Person'. Mann and co-workers have described eight general types of students and believe that they 'bring startlingly different needs and agendas to their interactions with teachers' (Mann *et al.* 1970). What adds to the complexity of clinical teaching is the presence of the patient. Clinical supervisors should be able to find a balance between the learning needs of the students and their duty to protect and successfully treat the patients (Fugill 2005).

Medical educators recognised the importance of evaluating the effectiveness of clinical instructors (Copeland & Hewson 2000). Instruments have been developed and validated in order to be reliable and easy to use for a wide variety of clinical teaching settings (Copeland & Hewson 2000). Recently, dental educators have also recognised their value (McGrath *et al.* 2005, Youngson *et al.* 2008, Woolley *et al.* 2009). All these instruments are based on very well researched and accepted theoretical framework of effective teaching behaviours and as long as we recognise their limitations they can provide us with valuable information (Schönwetter *et al.* 2006).

Literature specific to effective teaching behaviours and student learning in clinical practice, whilst rich in medicine and nursing, it is limited in

dentistry (Fugill 2005). Fugill's study used a combination of interview and questionnaire techniques to 'explore some of the characteristics of student-teacher interaction that students find significant'. It emphasised the importance of feedback and demonstration to student learning as well as the responsibility of the clinical teacher to facilitative learning within clinical activity. It also stressed the importance of allowing the student a certain amount of autonomy and familiarising students with clinical self-assessment (Fugill 2005). In Schönwetter's study, effective clinical teaching was best defined by rapport. Furthermore, enthusiasm was perceived as an effective teaching quality (Schönwetter *et al.* 2006).

This experimental study used questionnaire techniques to explore if there was agreement between the students and supervisors on the quality of clinical teaching in Restorative Dentistry in the Dublin Dental School and Hospital and to identify any differences between three academic years. Furthermore, this study aimed to identify the existence of any similarities between students' and supervisors' perceptions of specific teaching behaviours that are most and least helpful in learning.

6.2 Materials and methods

Ethical approval was attained from the faculty research ethics group faculty of health sciences, Trinity College Dublin. After reviewing the literature a questionnaire was designed that consisted of 15 items which included a number of these behaviours that would be considered important for effective clinical teaching. By using a typical six (descriptors)-level Likert scale questionnaire and using as a guide the seven domains of clinical teaching by the Stanford Faculty Development Program (SFDP) and a clinical teaching effectiveness instrument (CTE) (Copeland & Hewson 2000), the students were invited to give their opinion on aspects of the clinical teaching such as the learning climate, control of sessions, communication of goals,

promoting understanding and retention, evaluation, feedback and promotion of self-directed learning (Copeland & Hewson 2000).

Since students are usually reluctant to complete lengthy questionnaires for formative purposes we also designed it to be relatively short and convenient to use.

The format of question 16 was different. Students were asked to list (from 1-5) in order of importance (1 being the most important) the attributes that they consider to be most important in clinical teaching.

They were asked to list the following attributes:

- a. Enthusiasm/ approachability
- b. Giving positive and negative feedback in a way that helps learning
- c. Coaching on clinical/technical skills which are evidence based
- d. Stimulating independent learning by asking questions
- e. Making clear what should be known and done during clinics

Following question 16, space was provided for students to describe any other attributes that they would consider important.

The format of question 17 was similar to question 16. Students were asked to list (from 1-5) in order of importance (1 being the most important) the aspects of the clinical teaching that they consider to be least helpful.

They were asked to list the following aspects:

→ a. Lack of enthusiasm/interest in teaching
→ b. Giving a lot of negative feedback
→ c. Rarely giving positive feedback
→ d. Rarely giving help if a student is out of his/her depth

→ e. Disagreement about treatment plan amongst teachers

At the end of the question 17, space was again made available with a written invitation to describe any other aspects of clinical teaching that students would consider least helpful (Appendix 8.11,8.12).

Three cohorts of undergraduate students and three cohorts of clinical supervisors were surveyed. The questionnaire was circulated when the first student cohort (Group 1) was at the end of the 3rd year of the five year undergraduate programme (Bachelor of Dental Science). The second cohort (Group 2) was at the end the 4th year and the third cohort (Group 3) at the end of the 5th year. Each student was asked to complete one questionnaire and instructed that their answers should be based on their overall experience of the different supervisors they experienced in the Restorative Dentistry clinics. A similar questionnaire was circulated to the supervisors of these clinics.

The questionnaire was circulated to the participants at convenient times after explaining its purpose and addressing the question of anonymity. They were asked to fill them in and return them in a sealed posting box situated in a specified area. All returns were anonymous and the response rate was.

- Students 3rd year: (33/35) **94%**
- Students 4th year: (33/35) **94%**
- Students 5th year: (25/40) **63%**

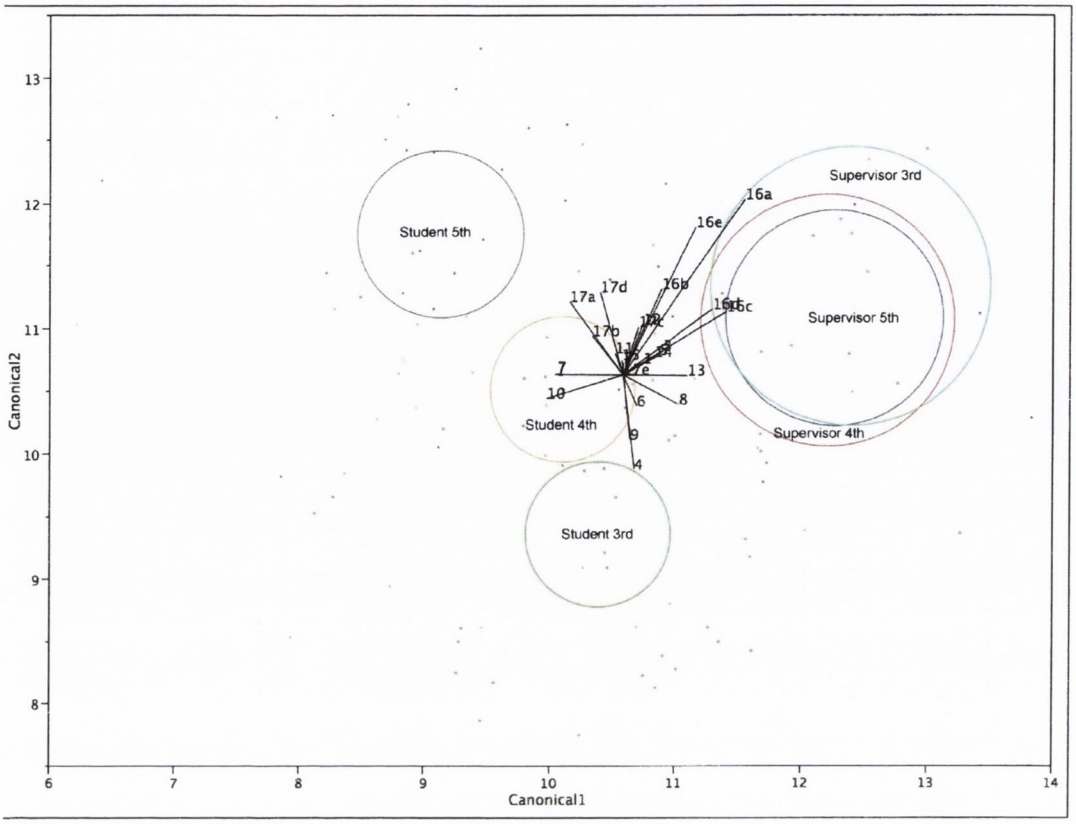
Out of the 36 supervisors that are involved in the clinical teaching of the students above, 21 returned the questionnaire. A number of them were supervising in Restorative Dentistry clinics in more than one year and they were asked to fill in 1 questionnaire for each year that they were supervising.

The descriptors for the first 15 questions were changed to numerical values (0-5) and these data were recorded on a Microsoft® Excel 2007

(Microsoft Inc., Redmond, WA, USA). Statistical analysis was carried out using JMP version 8 for Windows® statistical software (JMP Inc. SAS Campus Drive, Cary, North Carolina, USA). Basic analysis of the clinical questionnaire was carried out in order to find the distributions of the variables between the 3 student groups. These distributions, since they were non-normal, they were compared using a non-parametric analysis. (Kruskal – Wallis). The degree of association was measured by the Pearson's χ^2 values. Medians and IQrs rather than means and SDs were used as the data were skewed. Bonferroni correction for multiple hypothesis testing suggests that p-values need to be less than 0.002 before being considered as significant. Discriminate analysis was used in order to analyse the student/supervisor by year scoring. For the purpose of this analysis, 6 categories were formed. Two groups (student and supervisor) were defined for each of the 3 years.

In the discriminant analysis plot (canonical plot), the centre point in the plot with the lines radiating from it is the overall mean score across all questions and all categories (Figure 6.2-1). The lines correspond to the questions. The length of each line reflects how variable the responses to that question were. Long lines, means more variability and vice versa. Each category mean is a labelled circle giving an overall of 6 circles (the circle labelled "Supervisor 3rd" corresponds to supervisors in year 3 and so on). The size of the circle corresponds to a 95% confidence limit for the mean which means that large circles imply less precision for that category mean. Additionally, circles tend to be closer or further away from certain numbered lines (the questions). For example, questions 8, 13 are aligned closely with the supervisors across the 3 years. This means that the supervisors emphasised these questions.

Figure 6.2-1 Canonical Plot



Finally, the results of this study were relayed to the supervisors. The principal investigator met with them all (N= 31) personally and explained the reasons why their feedback was valuable. A questionnaire was constructed with the input of a clinical psychologist. This was initially piloted on two Dental Hospital staff members. It was subsequently circulated to the supervisors in Restorative Dentistry, together with a copy of the original study and related questionnaire, an information leaflet and a brief summary of the study (Appendix 8.13, 8.14). A total of 22 (N= 22) questionnaires were returned and all the comments were recorded on a Microsoft® Word 2007 (Microsoft Inc., Redmond, WA, USA) document.

6.3 Results

In the canonical plot (Figure 6.2-1), groups that are significantly different tend to have non-intersecting circles. It can be seen that the three categories comprising "year by supervisor" all overlap indicating that they do not differ significantly from one another in terms of their profiles

of responses to the questions over the 3 years. However, there are three circles that do not overlap with each other or with the groups. These three circles correspond to the three groups of students by year. As a result, it seems that the supervisors answer the questions with a good deal of similarly across the 3 years. The students have given different answers across the 3 years and they also differ with respect to the supervisors. (Full discriminant analysis scores in Appendix 8.15)

6.3.1 Student results

Students from all 3 groups scored the enthusiasm and approachability of their clinical supervisors above average (Likert scale 3-4). Furthermore they reported that the supervisors allowed them the appropriate autonomy and that after clinical sessions they usually felt stimulated and had a desire to learn more on their own. They also evaluated the way supervisors explain different procedures, the feedback that they receive from them and the way they adjust teaching to different settings as slightly above average.

Students from all three years reported that they were neither very satisfied nor very dissatisfied from their clinical teaching with a few statistically significant differences across the 3 years The clinical teaching was evaluated as slightly below average regarding organisation of clinical time and teaching of diagnostic, clinical, technical and communication skills. Additionally, students did not feel that they were taught efficiently about the principles of cost-appropriate care and they did not think that their clinical supervisors made enough effort to incorporate research data or guidelines into teaching.

There were some highly significant associations between year and level of response regarding the questions that clinical supervisors are asking in order to promote learning. 5th year students were clearly unimpressed while 4th and 3rd year students were relatively satisfied.

Figure 6.3-1 One way analysis of "ability of supervisors to organize clinics" by year (1 = 3rd, 2 = 4th, 3 = 5th)

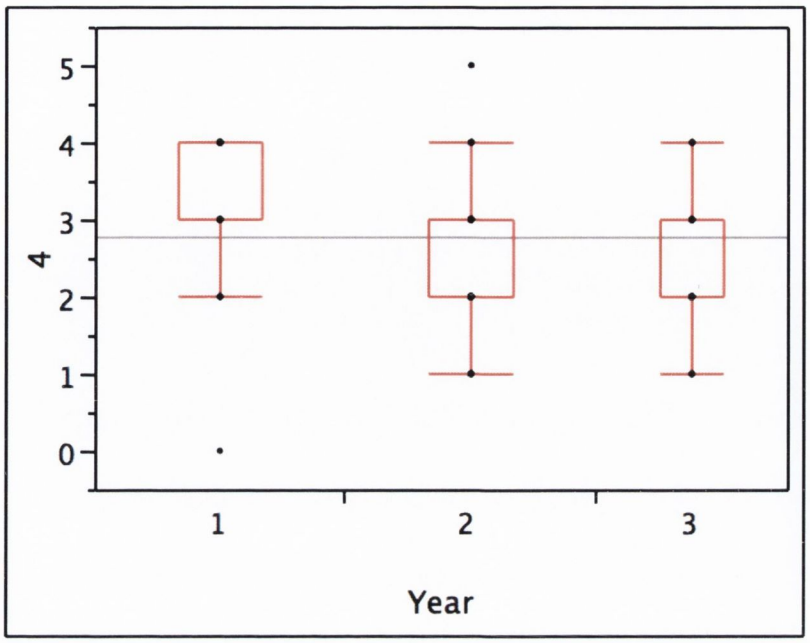


Table 6.3-1 Quantiles for the one way analysis in Figure 6.3-1

Level	Minimum	10%	25%	Median	75%	90%	Maximum
1	0	2	3	3	4	4	4
2	1	1	2	2	3	4	5
3	1	1	2	2	3	4	4

Table 6.3-2 Wilcoxon / Kruskal-Wallis tests (Rank Sums) for the one way analysis in Figure 6.3-1

Level	Count	Score Sum	Score Mean	(Mean-Mean0)/Std0
1	33	1975.00	59.8485	3.930
2	33	1258.00	38.1212	-2.234
3	25	953.000	38.1200	-1.822

Table 6.3-3 1-way test, Chi-squared approximation for the one way analysis in Figure 6.3-1

Chi-squared	DF	Prob>ChiSq
15.4771	2	0.0004

Highly significant difference between years. Year 3 differs from years 4 & 5.

Table 6.3-4 Contingency analysis of "ability of supervisors to organize clinics" by year

Count Col %	0	1	2	3	4	5	
3rd	1 100.00	0 0.00	4 14.29	12 41.38	16 66.67	0 0.00	33
4th	0 0.00	5 62.50	13 46.43	10 34.48	4 16.67	1 100.00	33
5th	0 0.00	3 37.50	11 39.29	7 24.14	4 16.67	0 0.00	25
	1	8	28	29	24	1	91

Table 6.3-5 Chi-squared values for the 6.3-4 contingency table

Test	Chi-squared	Prob>ChiSq
Pearson	24.208	0.0071

Highly significant association between year and level of response. Year 3 differs from years 4 & 5.

The 3rd year students were more satisfied than the other two cohorts by the ability of clinical supervisors to organise clinics in such a way that time was well spent for either teaching or treating.

Figure 6.3-2 One way analysis of "does the instructor ask questions that promote learning?" by year (1 = 3rd, 2 = 4th, 3 = 5th)

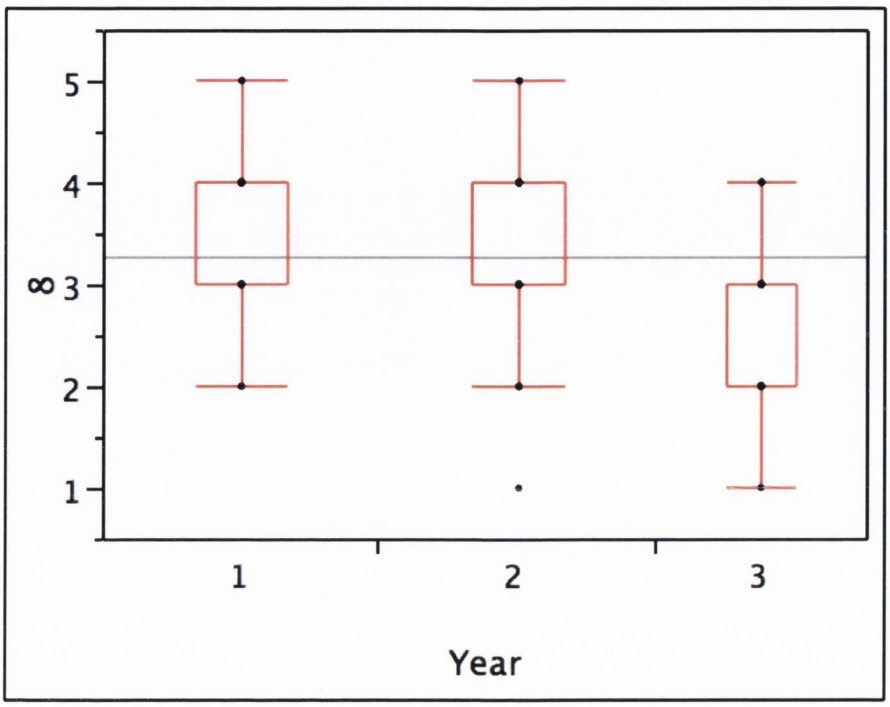


Table 6.3-6 Quantiles for the one way analysis in Figure 6.3-2

Level	Minimum	10%	25%	Median	75%	90%	Maximum
1	2	3	3	4	4	4	5
2	1	2	3	3	4	4	5
3	1	2	2	3	3	4	4

Table 6.3-7 Wilcoxon / Kruskal-Wallis tests (Rank Sums) for the one way analysis in Figure 6.3-2

Level	Count	Score Sum	Score Mean	(Mean-Mean0)/Std0
1	33	1844.00	55.8788	2.862
2	33	1610.50	48.8030	0.809
3	25	731.500	29.2600	-3.958

Table 6.3-8 1-way Test, Chi-squared approximation for the one way analysis in Figure 6.3-2

Chi-squared	DF	Prob>ChiSq
17.0451	2	0.0002

Highly significant difference between years. Year 5 differs from years 3 & 4.

Table 6.3-9 Contingency analysis of "Does the instructor ask questions that promote learning" by year

Count Col %	1	2	3	4	5	
3rd	0 0.00	2 13.33	11 31.43	18 51.43	2 50.00	33
4th	1 50.00	3 20.00	14 40.00	13 37.14	2 50.00	33
5th	1 50.00	10 66.67	10 28.57	4 11.43	0 0.00	25
	2	15	35	35	4	91

Table 6.3-10 Chi-squared values for the 6.3-9 contingency table

Test	Chi-squared	Prob>ChiSq
Pearson	20.253	0.0094

Highly significant association between year and level of response. Year 5 differs from years 3 & 4.

Table 6.3-11 Contingency analysis of question 9 by academic year

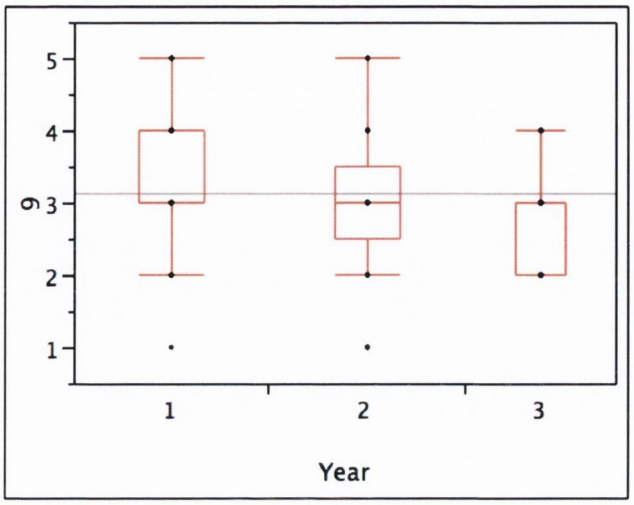
Count Col %	1	2	3	4	5	
3rd	1 20.00	5 29.41	11 27.50	10 50.00	6 66.67	33
4th	4 80.00	4 23.53	17 42.50	5 25.00	3 33.33	33
5th	0 0.00	8 47.06	12 30.00	5 25.00	0 0.00	25
	5	17	40	20	9	91

Table 6.3-12 Chi-squared values for the 6.3-11 contingency table

Test	Chi-squared	Prob>ChiSq
Pearson	15.672	**0.0473**

Significant association

Figure 6.3-3 One way analysis of question 9 by academic year (1 = 3rd, 2 = 4th, 3 = 5th)



Analysis of variance (Kruskal-Wallis) showed no significant differences (*p*=0.0552)

All cohorts listed enthusiasm as the most important attribute in clinical teaching. Making clear what should be known and expected during clinics were considered very important for the 3rd and 4th year students but not for the students in the 5th year who, considered evidence-based teaching as more important. When asked to list in order of importance the aspects of clinical teaching that they consider least helpful to learning, students from the 3rd and 4th year listed not receiving help when out of their depth as their number one choice. The 5th year students however considered disagreement about treatment plans amongst different teachers as the least helpful variable. As expected, all cohorts of students agreed that lack of enthusiasm is very unhelpful.

When students were asked for further comments they noted that they found the lack of communication between the supervisors when treatment plans are made particularly unhelpful. Furthermore, many supervisors were asked to cover certain clinics without being fully aware of the level of knowledge and experience of the students they are supervising. Finally students felt that very often there was not enough faculty coverage on the floor.

6.3.2 Supervisors results

The supervisors gave a high degree of straight line responses and generally felt very good about the level of clinical teaching. As mentioned before, supervisors replied with a great deal of similarity across the 3 years. They rated enthusiasm and approachability as the least important attribute for a supervisor in clinical teaching and they selected "giving positive and negative feedback in a way that helps learning" as the most important one. When they were asked to list in order of importance the aspects of clinical teaching that they consider to be least helpful to learning, "rarely giving help if a student is out of his/her depth" was their first choice and "rarely giving positive feedback" was their last. Furthermore, supervisors seemed to agree with the students in that they are not very efficient in teaching them the principles of cost-appropriate care. What is very interesting is the high degree of variability concerning what the supervisors thought was important but also the high degree of similarity in what they considered unhelpful. It was exactly the opposite for the students.

In their comments, supervisors stressed the importance of the ability of the supervisor to listen to the students and build confidence in them. They highlighted the lack of clarity on what the goals and objectives are for each year, which very often leads to inconsistent grading from members of staff. In their opinion, the problems above very often confused students, who, without knowing what was expected of them and being unsure about the definite treatment plan, were often poorly prepared for the clinical sessions (Statistical analysis of the rest of the data in Appendix 8.16).

6.4 Discussion

The validated questionnaire that was used as a guide (CTE) for this study was originally designed for rating the teaching effectiveness of clinical instructors in medicine. The changes that needed to be made in order to suit this study might have affected its sensitivity in picking up important details. Further limitations arise from the fact that only one institution was involved and although the response rate was satisfactory, the number of the students and staff involved was small and this sample cannot be characterised as broadly representative. Additionally, it would be interesting to investigate from an empirical basis the qualitatively different ways in which students and supervisors experience clinical teaching. Combining the data obtained from the current study with information gathered from meetings with staff and students in the form of focus groups could be a potential direction for future research.

Over the last few decades, several publications have tried to address a variety of questions regarding the effectiveness of clinical instruction in dentistry (Chambers *et al.* 2004, Henzi *et al.* 2006). The results were somewhat similar, with students evaluating highly the faculty members that showed enthusiasm and provided them with helpful and accurate feedback. Surprisingly, faculty members who approached effective clinical teaching from the perspective of being an expert were not perceived by students as effective (Shönwetter *et al.* 2006, Henzi *et al.* 2006) It is possible that this happens because an "expert" has unrealistic expectations from a student in training (Chambers *et al.* 2004, Henzi *et al.* 2006). Perhaps it is important for clinical supervisors to realise that enthusiasm and approachability is something that is greatly appreciated by the students.

In 2006, Henzi *et al.* tried to evaluate the effectiveness of clinical teaching from the perspective of the students. This perspective was provided by 655 dental students at twenty one North American schools

and the feedback they got was very similar with the feedback obtained from students in this study. They too rated their interaction with the instructors favourably but indicated similar areas of concern.

From the results of this study, it seems that student priorities and needs dramatically change over the course of their training. Clinical supervisors however seem to use a blanket approach to their teaching no matter which students they are supervising. In other words, they are failing to adapt to these changes. This observation is of particular importance if we take into consideration that most of these instructors are supervising students in different academic years. Dental schools need to do more to ensure that supervisors are fully aware of the level of knowledge and experience of the students they are supervising and what is expected from them. Subsequently, supervisors could concentrate on teaching what is important for the particular group of students and in turn students do not have to waste their valuable clinical time doing things that might not be part of their learning requirements (Chapnick & Chapnick 1999).

Lack of objectivity in the clinical assessment of students was another problem that was stressed by both students and supervisors. Again, lack of clear guidelines on how supervisors should assess clinical performance leads to inconsistent and many times unfair grading. According to Manogue *et al.* (2001), the most prevalent assessment tools in dental schools are clinical observations and competency exams regardless of the fact that portfolio-based learning and provision of consistent feedback to students is considered as more effective by the faculty members (Manogue *et al.* 2001).

Faculty shortages and rising costs of dental education are currently a universal problem for all dental schools. However, even in the current economic environment dental schools would benefit from improving their selection criteria for existing clinical supervisors and instigating regular evaluation of such staff. A supervisor that is constantly absent from the clinic on "coffee breaks" or otherwise engaged on a mobile

phone, could be perceived as manifestly uninterested in teaching. In their comments several students described situations such as this and commented on the negative effect that this behaviour has on their efforts to treat patients and meet the dental school's educational requirements. Reluctance or inability to take action against such behaviours may create tension resulting in a negative teaching environment.

As an emerging goal of curricula is to promote life-long learning attitudes, it is recommended that clinical supervisors should strive to be up-to-date in current best practice and evidence-based guidelines in their guidance of students. This shortcoming is echoed in one of the complaints of the final year students who reported that, although they consider evidence-based guidance of paramount importance, a number of clinical supervisors did not make enough effort to incorporate research data or guidelines into clinical teaching.

It is the responsibility of dental schools to select and provide suitable supervisors equipped with the necessary attitude in order to optimize learning across the broad spectrum of student cohorts. However, it should be recognised that motivation and the capabilities of the individual students also play a vital role in learning.

6.5 Conclusion

In this study there was a limited agreement on the effectiveness of clinical teaching and the way effectiveness is perceived between students and clinical supervisors as well as between senior and more junior students. Overall though students and supervisors rated clinical teaching favourably but indicated several areas of concern. It appears that in order to create a favourable learning environment, clinical instructors should show enthusiasm for their subject, be approachable, and provide students with helpful and accurate feedback in a programme that consists of clearly defined goals and objectives.

6.6 Publication details

This study was accepted for publication in the European Journal of Dental Education on the 27th July 2009. (Appendix 8.17).

6.7 Supervisors' feedback

In general, supervisors were interested to learn of the study results, and most were keen to offer further feedback by means of the second questionnaire. Most respondents were surprised by the high degree of variability between what students and supervisors feel is most and least helpful in learning. Furthermore, one dentist remarked that dentists are often more clear on what is unhelpful but less so on what is helpful. Many felt that this high degree of variability could be explained by the relative inexperience of the students rendering them unable to properly evaluate advice given by supervisors.

Supervisors were also taken aback that students rated enthusiasm and approachability as the most important attribute. One respondent would have thought that knowledge and understanding were more important to learning, otherwise students may be "enthusiastically misguided". Another supervisor felt that students recognised enthusiasm as the most important factor because it has "no link to education, knowledge or learning". Surprise was repeatedly expressed that students were concerned about cost-appropriate care. Respondents were also surprised that students' felt they were not effectively taught about cost-effective treatment as they are mostly taught by supervisors who work in private practice where such principles are paramount. While most supervisors felt they taught cost-appropriate care well, others disagreed. However, some reported that teaching of clinical skills should be prioritised over financial considerations in an educational environment in order to optimise learning.

Many supervisors were also surprised that students are dissatisfied with other aspects of teaching and believe that motivated students are getting a "fine education in advanced restorative care" but felt teaching

was not at same level in basic dental care. Surprise was expressed that students' perception of teaching of diagnostic, clinical, technical and communication skills was rated as below average, yet the students are not in favour of being questioned in order to promote learning. One supervisor concluded that "in other words, it seems students want to learn but do not wish to participate in the learning exercise".

Respondents' unanimously agreed with the supervisors' results, apart from one aspect. The results of the original questionnaire indicated that supervisors rated enthusiasm and approachability as least important to learning but responses in the feedback questionnaire disagree with this viewpoint. Most felt that these attributes are essential features of an effective teacher. Furthermore, some supervisors were surprised to realise that students rated these attributes so highly. One dentist also expressed amazement that supervisors' "rarely giving positive feedback" was rated as least helpful as he believed that "all students need encouragement".

When questioned regarding whether supervisors would consider incorporating aspects of these results into their clinical teaching, most intended to be more enthusiastic in their supervisory practice. Some, however, remarked that they would consider appearing more enthusiastic, but not at the expense of questioning and providing feedback. In addition, others intended to increase the use of guidelines and an evidence base as well as cost-appropriate care into their clinical teaching.

Respondents were overwhelmingly unsurprised by the results depicted in the graph (6.2-1). Of the many explanations that were proposed, the majority felt the discrepancy between student and supervisor responses was due to "experience vs. inexperience". It was suggested that both groups of people see things from their own perspective and that students and supervisors clearly have different objectives and agendas. Some felt that while instructors have gleaned experience in clinical teaching, the students are goal driven and have limited understanding

or knowledge of the curriculum structure. On the other hand, others believed that as students are much more 'tuned in' to the learning experience their views on what is important are bound to differ substantially from those who have not been involved in the educational system for many years. Only 2 respondents reported being surprised by the differences depicted in the graph (6.2-1). One was amazed to realise students and supervisors opinions differed so greatly, while the other suggested that both supervisors and students "need more formal training" in their communication skills.

Most respondents agreed that the findings of the questionnaire fitted in with their own observations of the student needs over the years. It was noted that the difference seen over the years shows development of critical thinking as the students mature. One respondent commented on the dynamic role of a supervisor which one must take into consideration when rating their efficacy. As students' progress over the years the supervisory role changes from a more directive role in 3rd year to an advisor / facilitator in 5th year. Some supervisors commented that often the best teachers are not recognised as such by students; those that give "an easy time" are preferred over those more challenging tutors.

In the questionnaire, students reported frustration when supervisors cannot agree on treatment plans. All respondents agreed that lack of clarity regarding treatment plans is a ubiquitous and ongoing issue. One respondent commented that this is not a new problem and he remembered similar issues as a dental student many years ago. The respondents offered two main schools of thought as to why this occurs and how it should be managed. The majority of respondents suggested that it is normal to have variation among treatment plans as there is nearly always a choice in a dynamic, biological profession like dentistry, and students have to learn to deal with this. Similarly, some felt variability was inevitable in dentistry as subjectivity is inherent and often there are many options in Restorative Dentistry. On the other hand, many supervisors sympathised with the students in this regard. They blamed the confusion on a lack of rigid guidelines on treatment due to

lack of staff training, and the differing skill and experience levels of the supervisors. Also implicated was the poor coordination in passing on the teaching that students receive in preclinical classes to the clinical supervisors. One supervisor even suggested that treatment plan variation is enhanced because a minority of supervisors "do not have enough knowledge". A further two respondents candidly stated that students often "shop around" for opinions and overemphasise differences, and that lack of clarity among treatment plans between supervisors is sometimes used by some students to their advantage as a way of "avoiding work".

Many respondents agreed that differing treatment plans are confusing for students in their early training years, as this takes "years of experience to understand". In agreement, a further respondent proposed that disagreement regarding treatment plans, although stimulating at graduate level, can be confusing for undergraduate students. Another supervisor recommended a more standardised approach to treatment planning for 3rd and 4th year students while those in 5th year should be challenged in this regard to promote diversity and stimulate students.

Different supervisors often have very different ideas regarding treatment plans. The primary solution suggested by many respondents was to ensure that large or contentious treatment plans are pre-approved and signed by a consultant. In this way, if a patient is transferred to another session with a different supervisor, there will not be a major issue. This would address another reported concern that treatment plans are provisionally made but often "never finalised". However, some respondents conveyed concern that there are currently "too few consultants" and who are usually "too busy" to make this suggestion feasible. It was also recommended that a student should start and finish a course of treatment with the same supervisor to reduce confusion. As treatment plan variation is a continual problem, many felt that evidence-based teaching was highly desirable and that supervisors would benefit

from regular meetings to update and synchronise knowledge to ensure more standardised teaching.

All the supervisors questioned stated that they value highly student feedback. In general, there was a strong feeling that such feedback was crucial to the progress and development of the training course. Some respondents specified that they equally value feedback from both a positive and a negative viewpoint. Only one supervisor suggested that because students have limited insight into the objectives and structure of the curriculum and tend to be exam / competence centred, there are times when their feedback may not be valuable.

Although supervisors reportedly value student feedback, the majority felt that there is usually insufficient time during clinic for individual attention. It was mentioned that at present, discussion time is particularly limited during clinic as all staff and students are busy learning the "new" electronic dental record system. One supervisor proposed that due to time restriction on clinic individual student progress is better evaluated by full-time staff. Some indicated that the more motivated students make it their business to find supervisors during extra-clinical hours in order to ensure discussion. Another like-minded respondent pointed out that often the best students give the most feedback, and not "those ones you actually want to engage with". In contrast, a few respondents felt that there was indeed adequate time on clinic for discussion. One respondent explained that regular dialogue with individual students is essential and can easily be fitted in during clinical time, for example when patients fail appointments or students finish early. Similarly, another supervisor reportedly makes a point of asking each student at end of each session how they feel they performed. Another respondent suggested that there is plenty of time on clinic for discussion in the early years but not as students' move into final year. However, all those who agreed that there was sufficient time also commented that timetabled feedback would indeed be more effective.

Almost all respondents felt there are few, if any, methods of official feedback and the vast majority were unaware of any formal feedback structures. Some even stated that they had never received feedback regarding students' experiences and needs. Most supervisors reportedly receive feedback informally by talking to students on clinic. It was suggested by many that the best way to get feedback is informally through a relaxed, casual one-to-one conversation with students, as learning is a "two way process". Many respondents emphasised the importance of "trying to get to know students as people" in order to "build a rapport", and felt that talking to students in a "friendly manner" is the most helpful way to encourage them to express their issues. In agreement, another supervisor believed that "dealing with things directly on clinic is better than allowing things to drag on" and recommended discussing any concerns about the clinical session before the student leaves the clinic. Other suggested methods of informal feedback included questioning, observation, as well as direct and indirect comments to staff members. Although informal feedback methods were considered important, almost all felt that current feedback methods were insufficient and recommended the introduction of formal feedback. Only one respondent questioned the usefulness of structured feedback, indicating that it "clearly has limitations given its subjective nature and the interpersonal differences" that exist between staff and students. In other words, a student may give a supervisor a negative review in response to receiving a bad grade or being reprimanded.

The minority of respondents that were aware of formal feedback structures, listed various methods by which feedback is obtained including questionnaires, zoomerang surveys', verbal interaction, by acting as a clinical academic advisor, through dental studies team and through discussion with individual clinical teachers. Only two respondents believed existing means of feedback were sufficient; unsurprisingly it was same two supervisors who had cited the existing formal feedback structures. Other supervisors commented that while they did receive formal feedback after core courses, laboratory sessions and PBL, they were unaware of any formal process for clinical

feedback. It was generally recommended that more feedback structures needed to be introduced, as current methods were deemed insufficient by almost all respondents. However, one supervisor did raise the concern regarding the risk of "feedback fatigue" if structures become too numerous. In summary, it appears everyone agrees feedback is important but very few supervisors are aware of the available structured, pathways that exist to execute this. This is a concern since if most staff are unaware of formal clinical feedback structures for students, who informs the students of such structures?

The respondents had many opinions regarding the role of a supervisor ranging from instilling confidence to academic encouragement. Suggestions were as follows: to support and encourage, to guide, to educate, to stimulate, to motivate, to listen, to reassure and to be aware of the students' limits. Some felt their main task was to act as a role model for professional ethical behaviour, while others suggested their primary role was as a mentor. More practically-based suggestions were to teach that care of the patient is central, to supervise the delivery of clinical care, to demonstrate practical skills, to integrate a scientific basis for clinical management, and to alert the school if a student is not progressing. Overall, "to teach" and "to protect patients" were considered the most significant supervisory roles.

The respondents were overwhelmingly in favour of introducing regular staff meetings involving both full-time and part-time staff members to ensure supervisors understand their role and what is expected of them. In-house training conducted by different departments was advocated to ensure that a consistent message is delivered to students. Some of those questioned proceeded to recommend additional meetings between clinical supervisors and academic advisors in order to enhance communication.

Other recommendations that emerged following this feedback questionnaire included: more faculty members on the clinical floor in advanced restorative sessions, more interaction with real patients to

enhance student learning, inclusion of a module on the economics of service provision to combat the reported lack of knowledge in cost-appropriate care, a module of laboratory work for 5th year students to enhance practical skills and a suggestion that student dissertations should commence in 4th year and be completed in 5th year, in order to allow more time. Furthermore, a number of respondents indicated the potential benefit of more lectures for students, as it was suggested that students seem "more concerned with research-based academic details and less with basic clinical principles".

Only one respondent felt there was no need for further research in either student learning or supervisory teaching practice. Of all the other supervisors who felt otherwise, many made interesting suggestions. One dentist advocated further research in student education using newer methods, including the use of combinations of media to reinforce learning. Another suggestion was to follow a cohort of dental students over a 5-year period to see if their perceptions change as they mature clinically. A further recommendation was to compare the student responses with their academic achievements, however, it is noteworthy that such a study could not be anonymous and therefore has inherent limitations. Two further recommendations were made for further research, to explore whether students prefer more recent graduates or older graduates as supervisors, and a further study to compare newer and long established, successful clinical teachers and to examine if older supervisors are up-to-date.

7 Overall discussion and conclusions

7.1 Overall discussion

When the Dublin Dental School and Hospital (DDSH) adopted a Problem Based Learning (PBL) curriculum it was the obvious choice in order to maintain their existing standards of excellence in higher education and to comply with the recommendations of the Bologna process. In theory, it is possible that PBL is superior to the traditional approach, but there is insufficient high quality evidence to support this claim. There is ongoing research focusing on the several interacting components of PBL and their effect on learning. Studies that aim to provide the required evidence to explore the relationship between theory and practice are already underway. However, lack of clear learning outcomes together with different university admission policies and a number of other factors, have hindered these investigations.

In an attempt to contribute to this body of evidence, the first study used questionnaire techniques to assess the attitude of both dentists and dental students towards life-long learning. Life-long learning is considered to be one of the major learning outcomes in all advanced dental programmes. PBL is believed to better prepare the students for self-directed learning, so our study endeavoured to investigate whether such claims could be supported. This study found no such evidence but managed to identify a number of professional and demographic variables that can influence a dentist's attitude toward life-long learning. In order to get additional information a number of the respondents were interviewed. It was reassuring to see that the feedback interview approach confirmed the majority of the results from the questionnaire. However, as it was previously pointed out, any curriculum comparison such as this has limited control over the changes that normally take place over a period of years. It must be remembered that the three student cohorts compared here had graduated over a time span of twelve years. It is possible that those who graduated many years ago

suffered a degree of recall bias when completing the questionnaire. It is also plausible that the learning attitudes of more recent PBL graduates were highly influenced by the "information age", while older graduates from a traditional curriculum may have been disadvantaged in this respect. Additionally, the lack of clear guidelines regarding CPD in Ireland has clearly hindered the efforts of practicing dentists to build upon whatever positive effects their undergraduate curriculum might have had, towards life-long learning.

Questionnaire research has been criticized over the years for being "soft science" with uncertain accuracy of recorded data and validity of reported results. However, over the last few years, several expert reviewers have agreed that well designed questionnaires can and do add valuable information to the pre-existing body of evidence (Chapple 2003). This study, like most studies in educational research, has a large number of limitations but has provided valuable information that can be used in further scientific studies.

There is also a suggestion that if students are selected without a reference to the full range of selected learning outcomes, there is a possibility that some of these students will have major deficiencies in their abilities at the end of their training (Clarke *et al.* 2004). It was investigated if current admission policies in our school had any negative effects in one of the most important learning outcomes; clinical competency. Results showed that although admission to the DDSH is based on the intellectual capacity of the applicant (in the form of secondary school grade point average), without taking a full range of outcomes into consideration, their progress was as expected and following training, all students advanced to a similar competence level.

It has been suggested that teachers need pedagogic education in order to be able to cope better with the different learning styles of different students. They should also be familiarized with the relevance of learning outcomes to teaching and assessment in order to help students map learning opportunities to outcomes. Furthermore,

assessment provides both students and teachers with feedback on the effectiveness of teaching and learning in terms of achieving specified learning outcomes (Clarke *et al.* 2004) Expectations are always very clear regarding clinical learning outcomes so our third study examined if there is an agreement between the students and the supervisors in the quality of clinical teaching in Restorative Dentistry in the DDSH. Although overall, students and supervisors rated clinical teaching favourably, it become apparent that neither the students nor the supervisors have a clear understanding or knowledge of the curriculum structure. Another reason for concern (obtained from the supervisor feedback questionnaire) is the lack of guidelines on treatment, due to lack of proper staff training and the poor coordination in passing on the teaching that students receive in preclinical classes to the clinical supervisors. Furthermore, although all supervisors value student feedback, most of them were unaware of any formal feedback structures regarding students' experiences and needs.

7.2 Overall conclusions

This thesis aimed to add to the literature discrete but interlinked areas of student engagement with the curriculum.

The teaching philosophy in the School, largely underpinned by the PBL approach, merited a review. Given the literature, albeit sparse, indicating that a problem-based learning approach theoretically strengthened a student's commitment to lifelong learning, the next phase of the study aimed to determine if this was in fact the case, from a questionnaire survey of qualified dentists. A follow-up questionnaire, to tease out some of the more pragmatic issues, revealed relevant issues that will need to be considered in establishing the delivery of formal continuing education (CDE) for dentists, as part of their continuing professional development (CPD), which will become formalised in Ireland in 2010.

A student's aptitude for a chosen course and/or career may be determined in part by their innate ability and skills. As with most third level education in Ireland, recruitment to a professional course like Dentistry relies solely on achievement of a certain number of points (GPA) at second level. Determining the level of innate skills, and the ability of the course to develop or not, such skills to achieve the intended learning outcomes, formed the third part of this piece of work. The insight of teachers on the course as to student needs, both clinical skill-based as well as more cognitive skills alongside the students' perceptions of their teaching and learning needs, constituted the fourth and final part of this study.

Although the introduction of PBL as the curriculum of choice in the DDSH was initially met with enthusiasm, there is a danger that interest in this innovation may be fading as time passes. There are indications from the results in Chapter 6 that not enough attention is being paid to linking the learning in PBL, lectures, seminars and laboratories to the application of this knowledge and skills acquisition to the clinical setting. In part, as indicated in the follow-up feedback from supervisors, the removal of full-time staff ('consultants') from not only the clinical areas but also PBL, has compounded this. Undoubtedly a curriculum must evolve and the challenge for faculty is to engage actively, in an ongoing way, with this process but not only with the process, rather, to achieve positive outcomes. Further research in this area must extend beyond one curriculum model and working collaboratively with other providers of dental education, to investigate the optimal blend that achieves the learning outcomes, will be fruitful.

A generation of dental professionals, not just dentists, are qualifying in the certain knowledge that continuing professional development (CPD) is their responsibility. As providers of education, our duty is to work across all sectors of education to ensure that we have not only imbued that sense in our graduates but also that we contribute to the quality assurance of the continuing dental education (CDE) that is provided. Research in this area will build on the baselines established as part of

this study, using the knowledge gained to develop appropriate delivery methods that are contemporary and relevant to meet the needs of all learners.

Ensuring career satisfaction for graduates is the responsibility, in part, of educators, but rests largely with the system in place to select students. The research has shown that relevant skills can be learned; what is not known is what attributes are required to not only make a good dentist truly great but also to ensure that their career in Dentistry remains satisfying and rewarding. Undoubtedly, there are research opportunities in this area, which should lead to the development of more robust criteria on which to base student selection.

The considerable disparity between students' and supervisors' perceptions about the learning experience on clinics points to the need for a greater engagement of these staff, mostly part-time, with the formal education process. From their feedback, the majority endorse this view and would actively welcome the opportunity to be more formally involved in pedagogy. This research sends a clear signal to educators that a review of the approach to delivering teaching and learning needs further refinement and the necessity to engage with those who have much to contribute. As with all other areas of this research, there is an acknowledgement in these results that any educational system has to be seen as dynamic. The faculty has to take responsibility for using this information to evolve the curriculum, involving all stakeholders in this process.

PBL was never proposed as panacea and needs to constantly evolve requiring continuous monitoring and quality assessment. One of the roles of dental education research is to facilitate the advancement of a curriculum by providing evidence-based solutions to problems that may arise following its implementation. A curriculum must evolve.

Research projects in collaboration with different dental schools that have similar characteristics in terms of pedagogy (or styles of teaching

and learning) with our own can be of great benefit. Long-term follow up of the progression of dental students over their academic years both at the preclinical and clinical level would also give us valuable information. Organization of regular staff meetings should also be prioritised in order to highlight the curriculum structure and lay down clear expectations of student performance. Finally, it is recommended that future research be undertaken to re-evaluate the attitudes of practicing dentists towards life-long learning subsequent to the introduction of compulsory CPD in Ireland.

8 Appendices

8.1 Publication details

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Problem Based learning in academic health education: a systematic literature review

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8.2 Questionnaire

A. Demographics

Year of graduation from the dental school: _____

☐Male ☐Female	
Year of birth: 19..... **Place of birth:** ☐ City ☐ Small town ☐ Rural area	**Marital status:** ☐ Married ☐ Single ☐ Divorced ☐ Separated
	Do you have Children? ☐ No ☐ Yes (If yes, how many? _____)
What was the occupation of your parents? Mother_____ Father_____	

B. Professional

Current position: ☐ **General dentist** ☐ **Specialist** ☐ **Postgraduate student** ☐ **Practice limited to** ..... ☐ **Other**.....	☐ Full time ☐ Part Time If part time, how many days do you work per week? _____
Working relation: ☐ **Private Practice** (owner of) - if yes, how many years after graduation did you open your own practice? _____ - if yes, how many people do you employ? Dentists____ Dental hygienists____ Nurses____ Clerical staff____ ☐ **Private Practice** (associate) ☐ **Hospital** ☐ **Health Services Executive** ☐ **Combination** (e.g HSE and general practice, general practice and hospital) ☐ **Other**	
You are working in: ☐ City ☐ Town ☐ Rural area	**What is your average monthly income?** ☐ Less than € 2,000 ☐ Less than € 5,000 ☐ More than € 5,000

C. Continuous Education

1. Do you currently subscribe to a dental /medical journal?

☐ No ☐ Yes

If yes, please list the journal(s) to which you subscribe.

_____

_____

_____

2. Do you have on-line access to journals via your practice or hospital settings?

☐ No ☐ Yes

3. Are you a member of a dental association/ federation /society/ academy e.t.c?

☐ No ☐ Yes

If yes, please list the ones in which you are a member.

_____

_____

_____

4. How many conferences have you attended in the last 2 years?

☐ None ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 5+

5. How many practical (Hands on) courses have you attended in the last two years?

☐ None ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 5+

6. How many days did you devote last year to continuous education/ further professional development?

☐ None ☐ 1-5 ☐ 5-10 ☐ 10+

7. What is the most effective way for you to keep up with latest professional developments?

☐ Journals

☐ Conferences

☐ Study groups / discussion with colleagues

☐ Courses

☐ Work in dental School

☐ Personal study

☐ Search on the internet

☐ Other

8. Dental procedures that you would considered appropriate to carry out on a patient currently receiving IV bisphosphonates.

☐ Scale and polish

☐ Dental implants

☐ Endodontic instrumentation

☐ Minor oral surgery procedures

9. Which medicament do you choose for pulpotomy procedures in primary molars

☐ Formocresol

☐ Ferric sulphate

☐ Calcium hydroxide

☐ I do not carry out this procedure

10. Which would be your drug of choice for the treatment of acute pain?

☐ Nimesulid

☐ Paracetamol

☐ Ibuprofen

☐ Other _____

11. Bitewing radiographs for the detection of dental caries.

☐ Should be based on a caries risk assessment

☐ Should always be taken when assessing a patient for caries

☐ Should be taken only if you can detect caries clinically

☐ Not necessary

12. After replantation of an avulsed permanent tooth with closed apex on a 20 year old patient you need to administer systemic antibiotics.
Which of the following would be you first choice.

☐ Penicillin V

☐ Clindamycin

☐ Tetracycline

☐ Erythromycin

For the following questions, please place a mark across the horizontal line at a point that best expresses your feelings between the two extremes.

1. I found my undergraduate course as a whole to be:

Neither stimulating nor enjoyable ——— stimulating and enjoyable

2. My ability to practice dentistry safely just after completing the course:

Not confident ——— Very confident

3. My ability to communicate with the patients just after completing the course

Not confident ——— Very confident

4. My ability to keep up to date with developments in dentistry just after completing the course

Not confident ——— Very confident

8.3 Information letter

Dear Colleague,

We are carrying out a study investigating attitudes and careers among graduates of our curriculum in Dublin Dental School and Hospital. As you are one of our graduates, we would be extremely grateful for your help.

The aim of this study is to investigate the impact of our curriculum on the medium to long-term attitudes of the practicing dentist towards life-long learning. We hope this way to identify advantages and disadvantages of our instructional approaches and investigate their available evidence base.

Finally, this study will also try to identify the factors which influence professional characteristics and development of the practicing dentist in medium-long term.

Your contribution would greatly help us improve the education offered in the Dublin Dental School and Hospital and therefore we hope that as one of our graduates you will consider devoting a few minutes of your time to fill in this questionnaire. Please respond to the simple questions in the pages that follow and return it to us in the addressed and pre-stamped envelop.

Any information collected will be treated in strict confidence. The questionnaire is anonymous and care is taken so that individuals cannot be identified from details in the reports resulting from this study.

For your kind assistance I thank you in advance

Sincerely yours

Ioannis Polyzois
Lecturer in Periodontology
Dublin Dental School and Hospital
Lincoln Place
Dublin 2

8.4 Life -long learning feedback interview

What does Continuing Professional Development (CPD) mean to you?

_____

_____

In which ways, if any, do you keep up to date with the latest professional developments?

_____

_____

How important is it for you to follow latest professional developments?

_____

_____

Which factors have influenced/informed your attitudes towards life long learning?

_____

_____

Have you faced any difficulties/obstacles in keeping up to date with the latest developments? If so, what has helped you to overcome these?

_____

_____

In which way, if any, has your undergraduate curriculum influenced your attitude towards life long learning?

_____

_____

In which way, if any, have your supervisors during your undergraduate studies influenced your attitude towards life-long learning?

_____

_____

In which way, if any, do you think that postgraduate studies influence the attitude of dentists towards life long-learning?

_____

_____

To what extent do you think that working hours can influence a dentists' commitment to CPD?

To what extent, does your current working position influence your approach to CPD?

What is your view about introducing compulsory CPD? Advantages/disadvantages?

Could you give me an example of a recent CPD activity you engaged in that you most/least enjoyed?

What influenced your decision making to attend this event or follow this CPD activity?

What do you think is the most effective way for you to keep up-to-date with the latest professional developments and why?

What motivates your commitment to/ participation in CPD courses?

What facilitates/helps you in participating in CPD? Can you give an example of how your workplace/ professional organization has helped/hindered your participation in a CPD activity?

What support do you think dentists might benefit from in order to keep up-to-date with latest professional developments and fulfil CPD? a) Support from a professional organisation (i.e. clear instructions, opportunities, forms of recording CPD) b) Support from workplace (i.e. time off, flexible hours, active participation into planning CPD-available structures in place c) Support from others (i.e. family).

_____

_____

What resources do you think dentists might benefit from in order to follow CPD (i.e. access to information on-line)

_____

_____

Can you give an example of a time that you were willing to attend a CPD event and you did not. What stopped you at that time?

_____

_____

What are the most common barriers to participate in CPD activities that you/ dentists are facing? (i.e. time, money, other obligations, location, negative workplace attitude towards CPD)

_____

_____

What other barriers to engaging in CPD can you think of?

_____

_____

What do you think can help dentists to overcome these barriers?

_____

_____

Year of birth_____

Year of graduation_____

Male/Female_____

Marital status_____

Children_____

Current position(s) _____

Full/Part time_____

Post-graduate studies_____

8.5 Distributions / basic analysis

Figure 8.5-1 Curriculum (1=Traditional), (2= Hybrid) and (3= PBL)

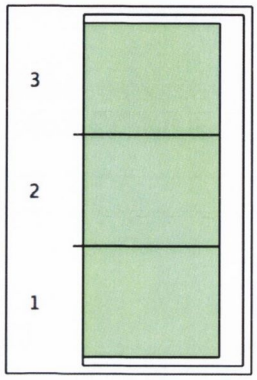


Table 8.5-1 Frequencies for curriculum

Level	Count	Prob
1	76	0.33333
2	76	0.33333
3	76	0.33333
Total	228	1.00000

Figure 8.5-2 Gender (1 = Male) & (2 = Female)

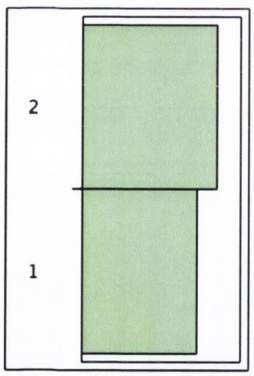


Table 8.5-2 Frequencies for gender

Level	Count	Prob
1	105	0.46053
2	123	0.53947
Total	228	1.00000

Figure 8.5-3 Year of birth

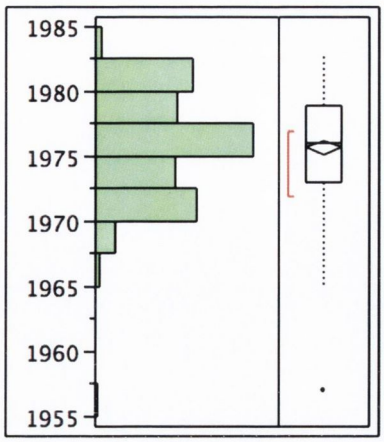


Table 8.5-3 Quantiles for year of birth

100.0%	maximum	1983.0
99.5%		1983.0
97.5%		1982.0
90.0%		1981.0
75.0%	quartile	1979.0
50.0%	median	1976.0
25.0%	quartile	1973.0
10.0%		1971.0
2.5%		1968.0
0.5%		1958.2
0.0%	minimum	1957.0

Table 8.5-4 Moments for year of birth

Mean	1975.6974
Std Dev	3.9199694
Std Err Mean	0.2596063
upper 95% Mean	1976.2089
lower 95% Mean	1975.1858
N	228

Figure 8.5-4 Place of Birth (1 = City), (2 = Small town) & (3 = Rural area)

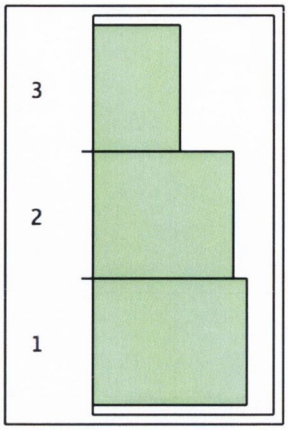


Table 8.5-5 Frequencies for place of birth

Level	Count	Prob
1	92	0.40351
2	84	0.36842
3	52	0.22807
Total	228	1.00000

Figure 8.5-5 Marital status (1 = Married), (2 = Single), (3 = Divorced) & (4 = Separated)

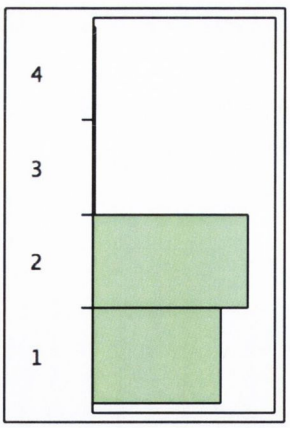


Table 8.5-6 Frequencies for marital status

Level	Count	Prob
1	102	0.44737
2	124	0.54386
3	1	0.00439
4	1	0.00439
Total	228	1.00000

Figure 8.5-6 Children (1 = No) & (2 = Yes)

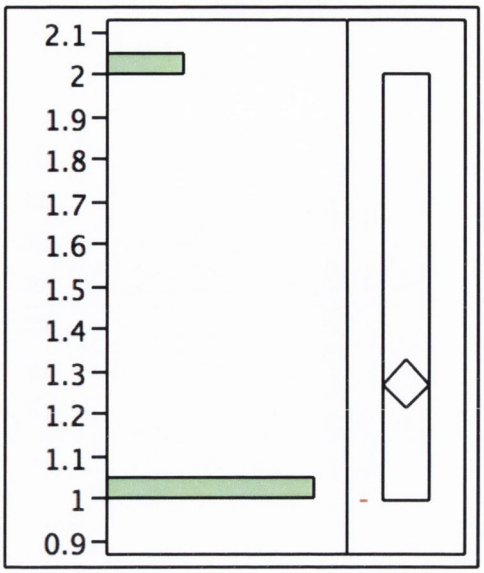


Table 8.5-7 Quantiles for children present

100.0%	maximum	2.0000
99.5%		2.0000
97.5%		2.0000
90.0%		2.0000
75.0%	quartile	2.0000
50.0%	median	1.0000
25.0%	quartile	1.0000
10.0%		1.0000
2.5%		1.0000
0.5%		1.0000
0.0%	minimum	1.0000

Table 8.5-8 Moments for children present

Mean	1.2719298
Std Dev	0.4459329
Std Err Mean	0.0295326
upper 95% Mean	1.330123
lower 95% Mean	1.2137367
N	228

Figure 8.5-7 If you have children, how many?

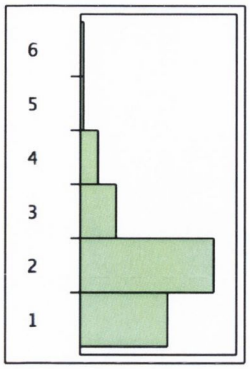


Table 8.5-9 Frequencies for number of children

Level	Count	Prob
1	19	0.30645
2	29	0.46774
3	8	0.12903
4	4	0.06452
5	1	0.01613
6	1	0.01613
Total	62	1.00000

Figure 8.5-8 Occupation of your mother: Levels 1-4 (4 = University education)

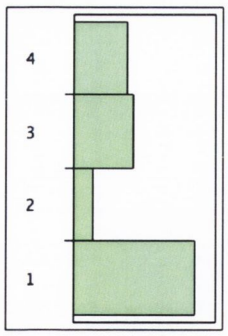


Table 8.5-10 Frequencies for mother's occupation

Level	Count	Prob
1	108	0.47368
2	18	0.07895
3	54	0.23684
4	48	0.21053
Total	228	1.00000

Figure 8.5-9 Occupation of your father: Levels 1-4 (4 = University education)

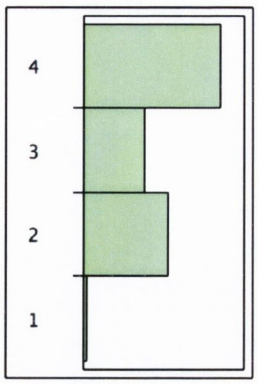


Table 8.5-11 Frequencies for father's occupation

Level	Count	Prob
1	3	0.01316
2	67	0.29386
3	49	0.21491
4	109	0.47807
Total	228	1.00000

Figure 8.5-10 Current position (1= GP, 2 = Specialist, 3 = Postgraduate student, 4 = Practice limited to & 5 = Other)

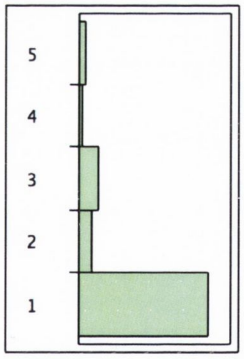


Table 8.5-12 Frequencies for current position

Level	Count	Prob
1	170	0.74561
2	18	0.07895
3	26	0.11404
4	5	0.02193
5	9	0.03947
Total	228	1.00000

Figure 8.5-11 Working full time = 1 & Working part time = 2

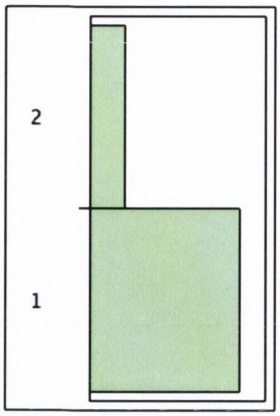


Table 8.5-13 Frequencies for working full time

Level	Count	Prob
1	185	0.81140
2	43	0.18860
Total	228	1.00000

Figure 8.5-12 If working part time, how many days per week?

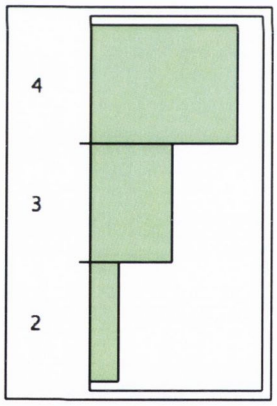


Table 8.5-14 Frequencies for the number of days a dentist is working per week

Level	Count	Prob
2	5	0.11364
3	14	0.31818
4	25	0.56818
Total	44	1.00000

Figure 8.5-13 Working relation: 1 = Private practice (owner), 2 = Private practice (associate), 3 = Hospital, 4 = Health services executive, 5 = Combination & 6 = Other.

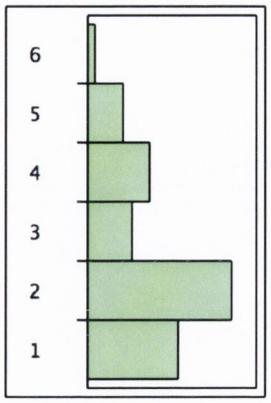


Table 8.5-15 Frequencies for working relation

Level	Count	Prob
1	54	0.23684
2	85	0.37281
3	26	0.11404
4	37	0.16228
5	21	0.09211
6	5	0.02193
Total	228	1.00000

Figure 8.5-14 If owner than how many years after graduation did you open your own practice?

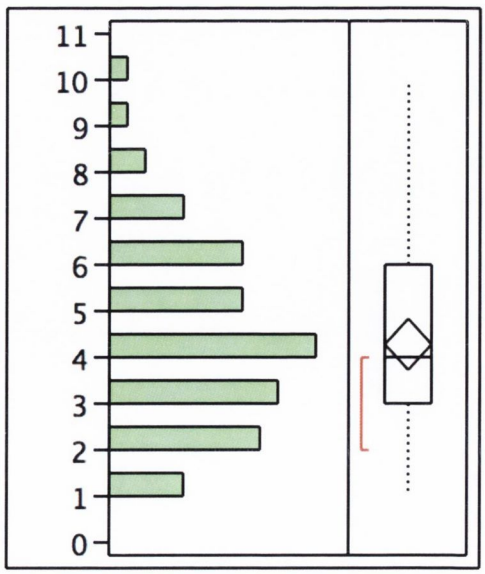


Table 8.5-16 Quantiles for number of years that it took the practicing dentist to open his/her own practice

100.0%	maximum	10.000
99.5%		10.000
97.5%		9.625
90.0%		7.000
75.0%	quartile	6.000
50.0%	median	4.000
25.0%	quartile	3.000
10.0%		2.000
2.5%		1.000
0.5%		1.000
0.0%	minimum	1.000

Table 8.5-17 Moments for the number of years that it took the practicing dentist to open his/her own practice

Mean	4.2777778
Std Dev	2.1138953
Std Err Mean	0.2876647
upper 95% Mean	4.8547601
lower 95% Mean	3.7007954
N	54

Figure 8.5-15 Number of dentists employed on average in the practices mentioned above (fig. 7-14).

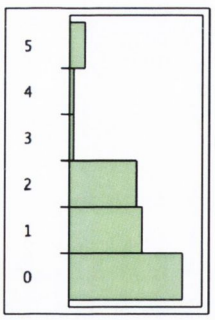


Table 8.5-18 Frequencies for the number of dentists employed

Level	Count	Prob
0	22	0.40741
1	14	0.25926
2	13	0.24074
3	1	0.01852
4	1	0.01852
5	3	0.05556
Total	54	1.00000

Figure 8.5-16 Number of dental hygienists employed on average in the practices mentioned above (Figure 7-14)

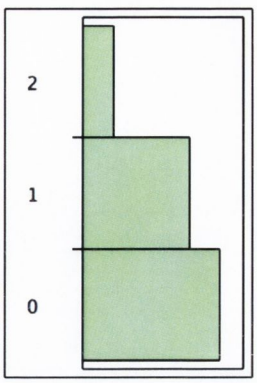


Table 8.5-19 Frequencies for the number of dental hygienists employed

Level	Count	Prob
0	27	0.50000
1	21	0.38889
2	6	0.11111
Total	54	1.00000

Figure 8.5-17 Number of nurses employed on average in the practices mentioned above (fig 7-14).

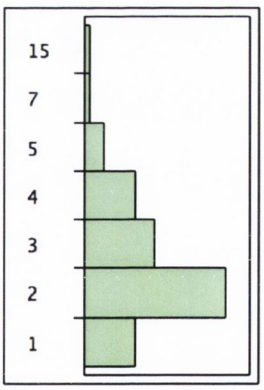


Table 8.5-20 Frequencies

Level	Count	Prob
1	8	0.14815
2	22	0.40741
3	11	0.20370
4	8	0.14815
5	3	0.05556
7	1	0.01852
15	1	0.01852
Total	54	1.00000

Figure 8.5-18 Number of clerical staff employed on average in the practices mentioned above (fig. 7-14).

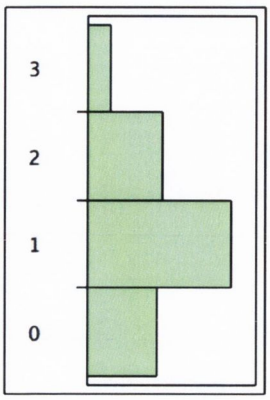


Table 8.5-21 Frequencies for the clerical staff employed

Level	Count	Prob
0	12	0.22222
1	25	0.46296
2	13	0.24074
3	4	0.07407
Total	54	1.00000

Figure 8.5-19 Place of work (1 = City, 2 = Town, 3 = Rural area)

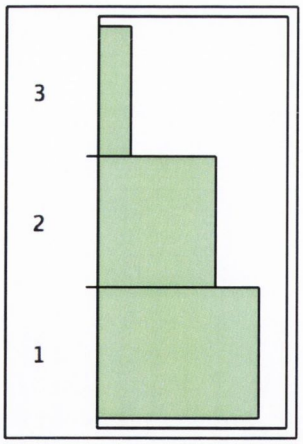


Table 8.5-22 Frequencies for place of work

Level	Count	Prob
1	118	0.51754
2	86	0.37719
3	24	0.10526
Total	228	1.00000

Figure 8.5-20 Average monthly income: (1 = Less than 2000€, 2 = Less than 5000€, 3 = More than 5000€)

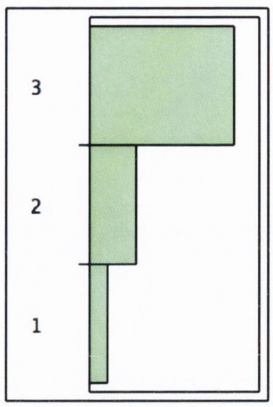


Table 8.5-23 Frequencies for average monthly income

Level	Count	Prob
1	20	0.08772
2	51	0.22368
3	157	0.68860
Total	228	1.00000

Figure 8.5-21 Do you currently subscribe to a medical / dental journal? (1 = No & 2 = Yes)

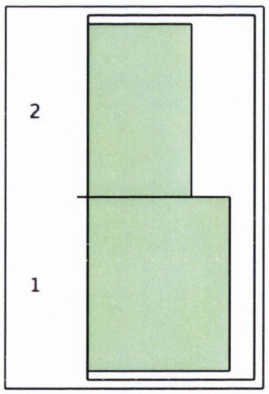


Table 8.5-24 Frequencies for subscription to a medical / dental journal

Level	Count	Prob
1	132	0.57895
2	96	0.42105
Total	228	1.00000

Figure 8.5-22 If yes, in how many?

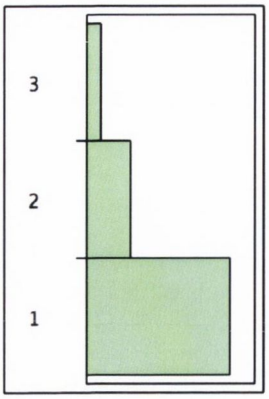


Table 8.5-25 Frequencies for the number of subscriptions to scientific journals

Level	Count	Prob
1	68	0.70833
2	21	0.21875
3	7	0.07292
Total	96	1.00000

Figure 8.5-23 Do you have online access to scientific journals? (1 = No & 2 = Yes)

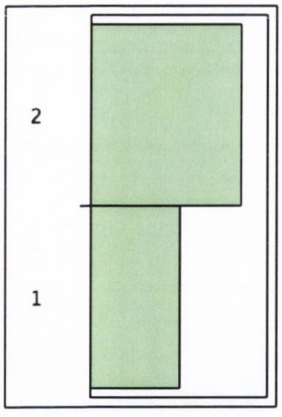


Table 8.5-26 Frequencies for the online access to scientific journals

Level	Count	Prob
1	85	0.37281
2	143	0.62719
Total	228	1.00000

Figure 8.5-24 Are you a member of a dental association, academy etc. (No = 1 & Yes = 2)

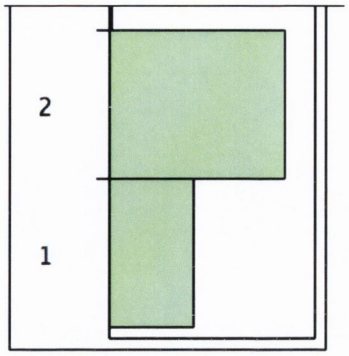


Table 8.5-27 Frequencies for being a member of a dental association, academy etc.

Level	Count	Prob
1	74	0.32456
2	154	0.67105
Total	228	1.00000

Figure 8.5-25 In how many dental associations, academies etc, are you a member?

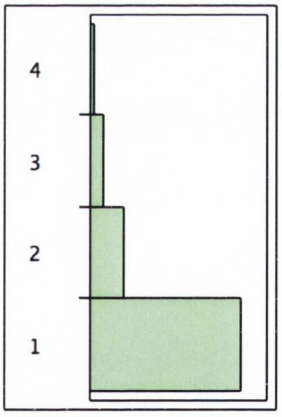


Table 8.5-28 Frequencies for the number of memberships

Level	Count	Prob
1	115	0.74194
2	26	0.16774
3	11	0.07097
4	3	0.01935
Total	155	1.00000

Figure 8.5-26 How many conferences have you attended in the last 2 years. (6 = 5+)

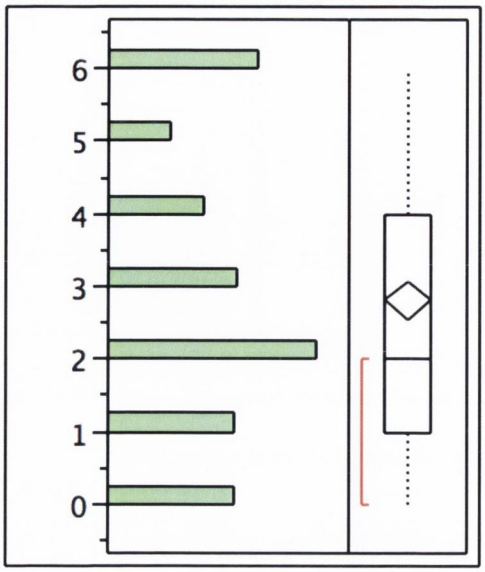


Table 8.5-29 Quantiles for the number of conferences attended in the last 2 years

100.0%	maximum	6.0000
99.5%		6.0000
97.5%		6.0000
90.0%		6.0000
75.0%	quartile	4.0000
50.0%	median	2.0000
25.0%	quartile	1.0000
10.0%		0.0000
2.5%		0.0000
0.5%		0.0000
0.0%	minimum	0.0000

Table 8.5-30 Moments for the number of conferences attended in the last 2 years

Mean	2.8114035
Std Dev	1.9810672
Std Err Mean	0.1311994
upper 95% Mean	3.0699279
lower 95% Mean	2.5528791
N	228

Figure 8.5-27 How many practicals (Hands on) courses have you attended in the last two years? (6 = 5+)

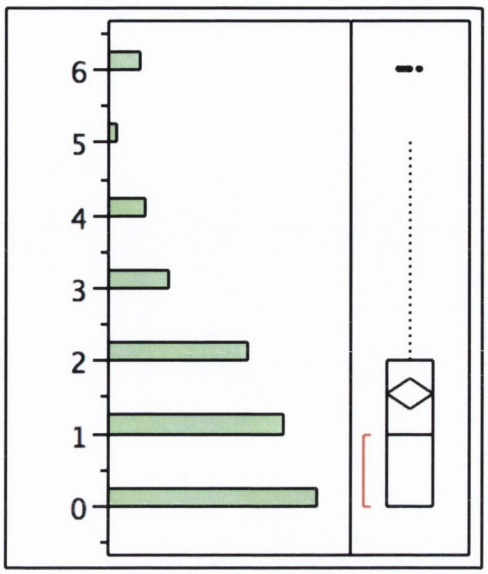


Table 8.5-31 Quantiles for the number of practical courses attended

100.0%	maximum	6.0000
99.5%		6.0000
97.5%		6.0000
90.0%		4.0000
75.0%	quartile	2.0000
50.0%	median	1.0000
25.0%	quartile	0.0000
10.0%		0.0000
2.5%		0.0000
0.5%		0.0000
0.0%	minimum	0.0000

Table 8.5-32 Moments for the number of practical courses attended

Mean	1.5438596
Std Dev	1.593712
Std Err Mean	0.1055462
upper 95% Mean	1.7518351
lower 95% Mean	1.3358842
N	228

Figure 8.5-28 How many days did you devote last year to continuous education/further professional development? (0 = none, 1 = 1-5, 2 = 5-10 & 3 = 10+)

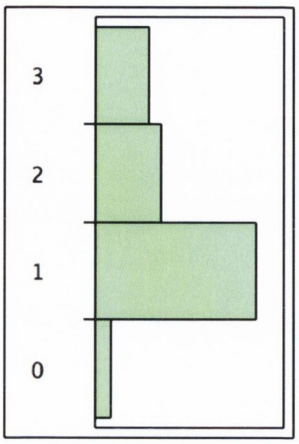


Table 8.5-33 Frequencies for the number of days devoted to CDE

Level	Count	Prob
0	13	0.05702
1	123	0.53947
2	50	0.21930
3	42	0.18421
Total	228	1.00000

Figure 8.5-29 What is the most effective way for you to keep up with latest professional developments? Journals ? (0 = No, 1= Yes).

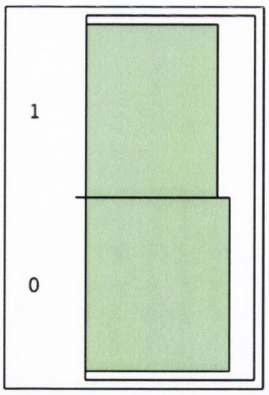


Table 8.5-34 Frequencies for journals as the most effective way to keep up with the latest professional developments

Level	Count	Prob
0	119	0.52193
1	109	0.47807
Total	228	1.00000

Figure 8.5-30 What is the most effective way for you to keep up with latest professional developments? Conferences? (0 = No, 1= Yes).

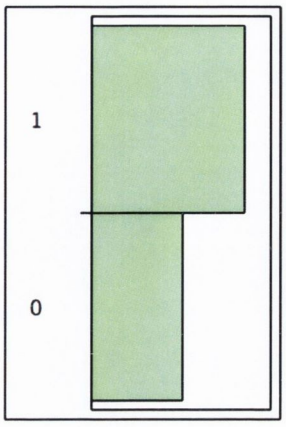


Table 8.5-35 Frequencies for conferences as the most effective way to keep up with the latest professional developments

Level	Count	Prob
0	85	0.37281
1	143	0.62719
Total	228	1.00000

Figure 8.5-31 What is the most effective way for you to keep up with latest professional developments? Study groups, discussion with colleagues? (0 = No, 1= Yes).

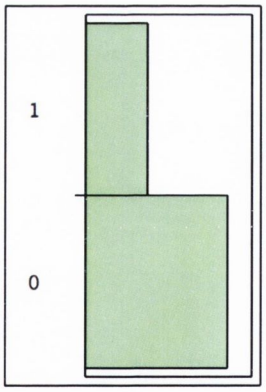


Table 8.5-36 Frequencies for study groups and discussion with colleagues as the most effective way to keep up with the latest professional developments

Level	Count	Prob
0	159	0.69737
1	69	0.30263
Total	228	1.00000

Figure 8.5-32 What is the most effective way for you to keep up with latest professional developments? Courses? (0 = No, 1= Yes).

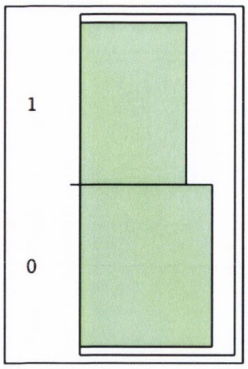


Table 8.5-37 Frequencies for courses as the most effective way to keep up with the latest professional developments

Level	Count	Prob
0	127	0.55702
1	101	0.44298
Total	228	1.00000

Figure 8.5-33 What is the most effective way for you to keep up with latest professional developments? Work in dental school? (0 = No, 1= Yes).

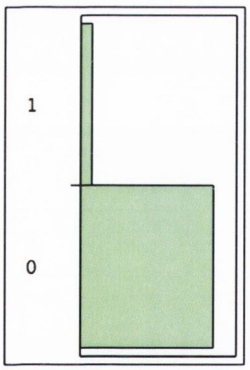


Table 8.5-38 Frequencies for working in the dental school as the most effective way to keep up with the latest professional developments

Level	Count	Prob
0	209	0.91667
1	19	0.08333
Total	228	1.00000

Figure 8.5-34 What is the most effective way for you to keep up with latest professional developments? Personal study? (0 = No, 1= Yes).

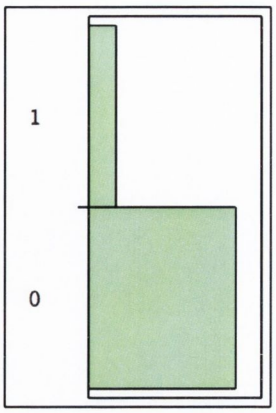


Table 8.5-39 Frequencies for personal study as the most effective way to keep up with the latest professional developments

Level	Count	Prob
0	192	0.84211
1	36	0.15789
Total	228	1.00000

Figure 8.5-35 What is the most effective way for you to keep up with latest professional developments? Internet? (0 = No, 1= Yes).

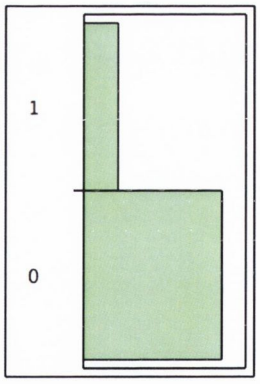


Table 8.5-40 Frequencies for internet as the most effective way to keep up with the latest professional developments

Level	Count	Prob
0	182	0.79825
1	46	0.20175
Total	228	1.00000

Figure 8.5-36 What is the most effective way for you to keep up with latest professional developments? Other? (0 = No, 1= Yes).

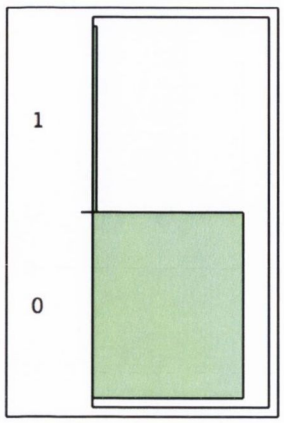


Table 8.5-41 Frequencies for "other ways" as the most effective way to keep up with the latest professional developments

Level	Count	Prob
0	220	0.96491
1	8	0.03509
Total	228	1.00000

Figure 8.5-37 Question no 8 (Appendix 7-2) *page 89*. (0 = wrong, 1= wright).

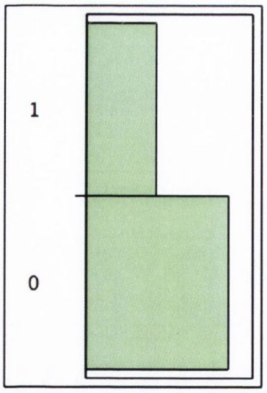


Table 8.5-42 Frequencies for question no 8

Level	Count	Prob
0	153	0.67105
1	75	0.32895
Total	228	1.00000

Figure 8.5-38 Question no 9 (Appendix 7-2) *page 89*. (0 = wrong, 1= wright).

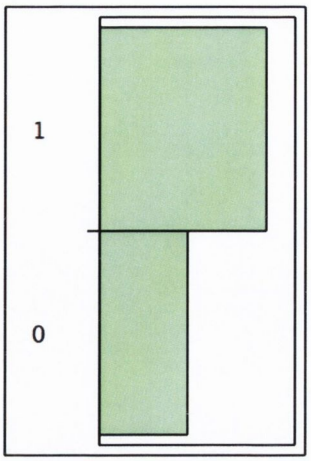


Table 8.5-43 Frequencies for question no 9

Level	Count	Prob
0	79	0.34649
1	149	0.65351
Total	228	1.00000

Figure 8.5-39 Question no 10 (Appendix 7-2) *page 90*. (0 = wrong, 1 = wright).

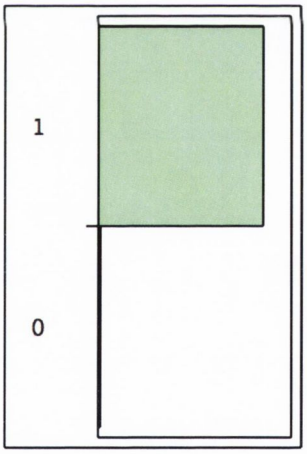


Table 8.5-44 Frequencies for question no 10

Level	Count	Prob
0	3	0.01316
1	225	0.98684
Total	228	1.00000

Figure 8.5-40 Question no 11(Appendix 7-2) *page 90*. (0 = wrong, 1 = wright).

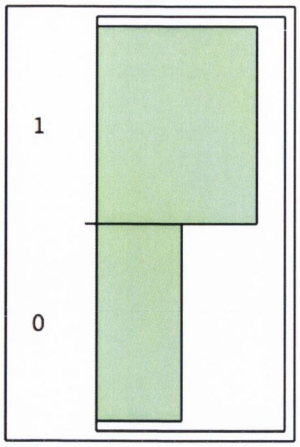


Table 8.5-45 Frequencies for question no 11

Level	Count	Prob
0	79	0.34649
1	149	0.65351
Total	228	1.00000

Figure 8.5-41 Question no 12 (Appendix 7-2) *page 90*. (0 = wrong, 1= wright).

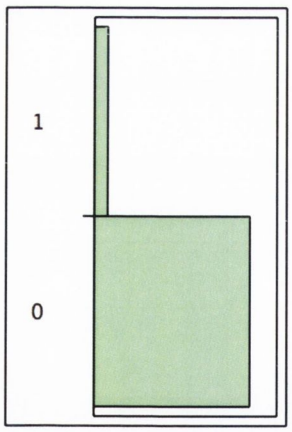


Table 8.5-46 Frequencies for question no 12

Level	Count	Prob
0	208	0.91228
1	20	0.08772
Total	228	1.00000

Figure 8.5-42 VAS results of how enjoyable and stimulating undergraduate course was perceived to be. (0-10)

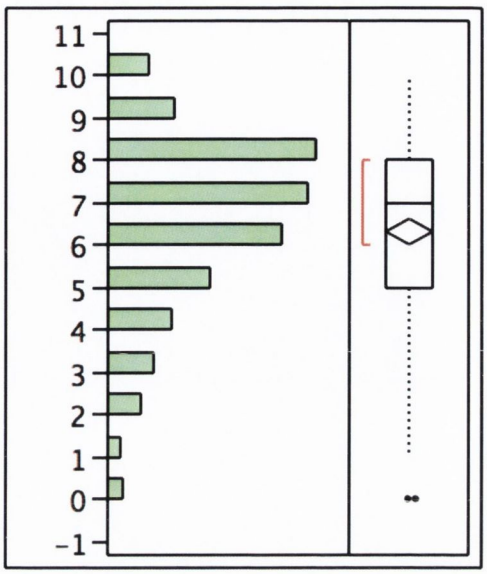


Table 8.5-47 Quantiles for VAS question no 1

100.0%	maximum	10.000
99.5%		10.000
97.5%		10.000
90.0%		9.000
75.0%	quartile	8.000
50.0%	median	7.000
25.0%	quartile	5.000
10.0%		3.000
2.5%		1.000
0.5%		0.000
0.0%	minimum	0.000

Table 8.5-48 Moments for VAS question no 1

Mean	6.3289474
Std Dev	2.1530932
Std Err Mean	0.1425921
upper 95% Mean	6.6099207
lower 95% Mean	6.047974
N	228

Figure 8.5-43 VAS results of how confident dentists felt to practice dentistry after completing their undergraduate course. (0-10)

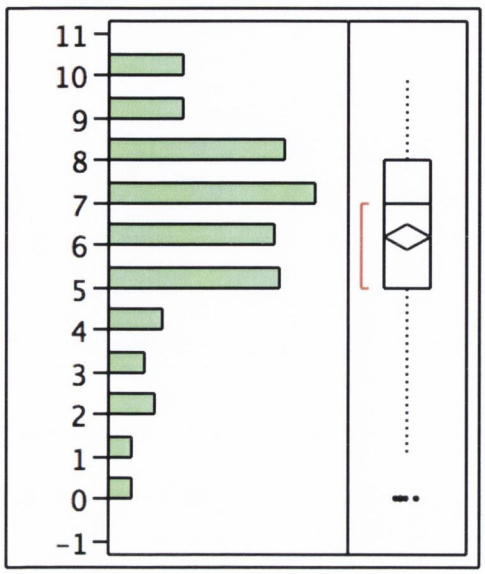


Table 8.5-49 Quantiles for VAS question no 2

100.0%	maximum	10.000
99.5%		10.000
97.5%		10.000
90.0%		9.000
75.0%	quartile	8.000
50.0%	median	7.000
25.0%	quartile	5.000
10.0%		3.000
2.5%		0.725
0.5%		0.000
0.0%	minimum	0.000

Table 8.5-50 Moments for VAS question no 2

Mean	6.2324561
Std Dev	2.3055954
Std Err Mean	0.1526918
upper 95% Mean	6.5333306
lower 95% Mean	5.9315816
N	228

Figure 8.5-44 VAS results of how able the dentists felt to communicate with their patients after completing their undergraduate course (0-10)

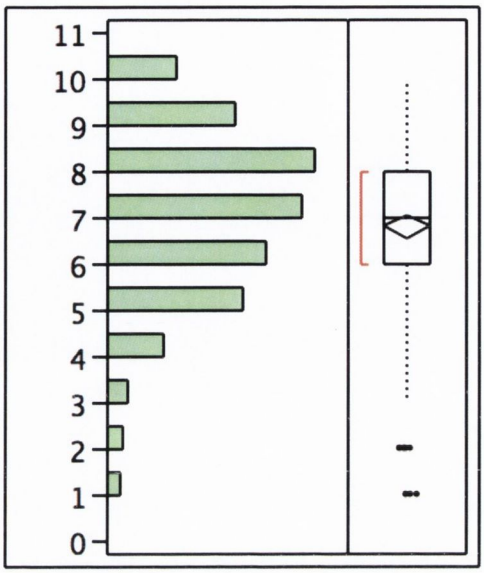


Table 8.5-51 Quantiles for VAS question no 3

100.0%	maximum	10.000
99.5%		10.000
97.5%		10.000
90.0%		9.000
75.0%	quartile	8.000
50.0%	median	7.000
25.0%	quartile	6.000
10.0%		4.000
2.5%		2.000
0.5%		1.000
0.0%	minimum	1.000

Table 8.5-52 Moments for VAS question no 3

Mean	6.8157895
Std Dev	1.9512372
Std Err Mean	0.1292238
upper 95% Mean	7.0704211
lower 95% Mean	6.5611578
N	228

Figure 8.5-45 VAS results of how able the dentists felt in keeping up to date with developments in dentistry after completing their undergraduate course. (0-10)

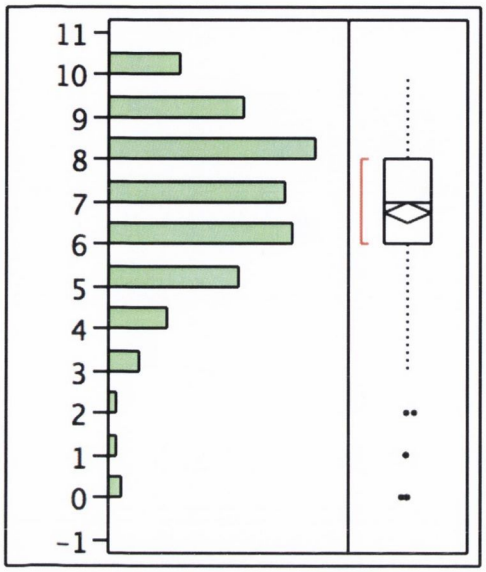


Table 8.5-53 Quantiles for VAS question no 4

100.0%	maximum	10.000
99.5%		10.000
97.5%		10.000
90.0%		9.000
75.0%	quartile	8.000
50.0%	median	7.000
25.0%	quartile	6.000
10.0%		4.000
2.5%		1.725
0.5%		0.000
0.0%	minimum	0.000

Table 8.5-54 Moments for VAS question no 4

Mean	6.7587719
Std Dev	2.0475971
Std Err Mean	0.1356054
upper 95% Mean	7.0259783
lower 95% Mean	6.4915656
N	228

8.6 *Statistical analysis of the rest of the data collected from the questionnaire*

Table 8.6-1 Contingency analysis of the question (Do you currently subscribe to a dental /medical journal?) by type of curriculum

Count Col % Row %	No	Yes	
Trad	42 31.82 55.26	34 35.42 44.74	76
Hybrid	42 31.82 55.26	34 35.42 44.74	76
PBL	48 36.36 63.16	28 29.17 36.84	76
	132	96	228

Chi-squared values

Test	Chi-squared	Prob>ChiSq
Likelihood Ratio	1.305	0.5208
Pearson	1.295	**0.5232**

Contingency analysis of the association between curriculum and the number of subscriptions to scientific journals did not produce statistical significance (χ^2, Pearson's, p=0.5232).

Table 8.6-2 Contingency analysis of the question (Do you have on-line access to journals via your practice or hospital settings?) by type of curriculum

Count Col % Row %	No	Yes	
Trad	26 30.59 34.21	50 34.97 65.79	76
Hybrid	24 28.24 31.58	52 36.36 68.42	76
PBL	35 41.18 46.05	41 28.67 53.95	76
	85	143	228

Chi-squared values

Test	Chi-squared	Prob>ChiSq
Likelihood Ratio	3.829	0.1474
Pearson	3.864	**0.1449**

Contingency analysis of the association between curriculum and on-line access to journals did not produce statistical significance. (χ^2, Pearson's, p=0.1449).

Table 8.6-3 Contingency Analysis of the question (Are you a member of a dental association/ federation /society/ academy e.t.c?) by type of curriculum

Count Col % Row %	No	Yes	
Trad	19 25.7 25.0	57 37.0 75.0	76
Hybrid	26 35.1 34.2	50 32.5 65.8	76
PBL	29 39.2 38.2	47 30.5 61.8	76
	74	154	228

Chi-squared values

Test	Chi-squared	Prob>ChiSq
Likelihood Ratio	3.161	0.206
Pearson	3.221	**0.200**

Contingency analysis of the association between curriculum and being a member of a dental society etc. did not produce statistical significance (χ^2, Pearson's, p=0.2).

Table 8.6-4 Contingency analysis of the question (How many conferences have you attended in the last 2 years?) by type of curriculum

Count Total % Col % Row %	0	1	2	3	4	5	5+	
Trad	10 4.39 31.25 13.16	9 3.95 28.13 11.84	16 7.02 30.19 21.05	15 6.58 45.45 19.74	9 3.95 37.50 11.84	7 3.07 43.75 9.21	10 4.39 26.32 13.16	76 33.33
Hybrid	14 6.14 43.75 18.42	9 3.95 28.13 11.84	17 7.46 32.08 22.37	4 1.75 12.12 5.26	9 3.95 37.50 11.84	8 3.51 50.00 10.53	15 6.58 39.47 19.74	76 33.33
PBL	8 3.51 25.00 10.53	14 6.14 43.75 18.42	20 8.77 37.74 26.32	14 6.14 42.42 18.42	6 2.63 25.00 7.89	1 0.44 6.25 1.32	13 5.70 34.21 17.11	76 33.33
	32 14.04	32 14.04	53 23.25	33 14.47	24 10.53	16 7.02	38 16.67	228

Chi-squared values

Test	Chi-squared	Prob>ChiSq
Likelihood Ratio	20.420	0.0595
Pearson	17.655	**0.1266**

Contingency analysis of the association between curriculum and number of conferences these dentists attended over the last 2 years did not produce statistical significance (χ^2, Pearson's, p=0.1266).

Table 8.6-5 Contingency analysis of the question (How many practical (Hands on) courses have you attended in the last two years?) by type of curriculum

Count Col % Row %	0	1	2	3	4	5	5+	
Trad	26 36.11 34.21	18 30.00 23.68	19 39.58 25.00	7 33.33 9.21	2 15.38 2.63	0 0.00 0.00	4 36.36 5.26	76
Hybr	23 31.94 30.26	21 35.00 27.63	12 25.00 15.79	8 38.10 10.53	7 53.85 9.21	1 33.33 1.32	4 36.36 5.26	76
PBL	23 31.94 30.26	21 35.00 27.63	17 35.42 22.37	6 28.57 7.89	4 30.77 5.26	2 66.67 2.63	3 27.27 3.95	76
	72	60	48	21	13	3	11	228

Chi-squared values

Test	Chi-squared	Prob>ChiSq
Likelihood Ratio	8.468	0.7476
Pearson	7.566	**0.8181**

Contingency analysis of the association between curriculum and number of hands on courses these dentists attended over the last 2 years did not produce statistical significance (χ^2, Pearson's, p=0.8181).

Table 8.6-6 Contingency analysis of the question (Do you currently subscribe to a dental /medical journal?) by gender

Count Col % Row %	No	Yes	
Male	60 45.45 57.14	45 46.88 42.86	105
Female	72 54.55 58.54	51 **53.13** 41.46	123
	132	96	228

Fisher's exact test

Fisher's Exact Test	Prob
Left	0.0175
Right	0.9915
2-Tail	**0.0284**

Contingency analysis of the association between gender and the number of subscriptions to scientific journals did produce statistical significance (2-Tail, Fisher's exact test, p=0.0284). Females, subscribed to more journals when compared to their male colleagues.

Table 8.6-7 Contingency analysis of the question (Are you a member of a dental association/ federation /society/ academy etc?) by gender

Count Col % Row %	No	Yes	
Male	31 41.9 29.5	74 48.1 70.5	105
female	43 58.1 35.0	80 51.9 65.0	123
	74	153	228

Chi-squared values

Test	Chi-squared	Prob>ChiSq
Likelihood Ratio	0.766	0.382
Pearson	0.763	**0.382**

Contingency analysis of the association between gender and being a member of a dental society etc., did not produce statistical significance (χ^2, Pearson's, p=0.382).

Table 8.6-8 Contingency analysis of the question (How many conferences have you attended in the last 2 years?) by gender

Count Total % Col % Row %	0	1	2	3	4	5	5+	
Male	14 6.14 43.75 13.33	12 5.26 37.50 11.43	20 8.77 37.74 19.05	18 7.89 54.55 17.14	13 5.70 54.17 12.38	10 4.39 62.50 9.52	18 7.89 47.37 17.14	105 46.05
Fem	18 7.89 56.25 14.63	20 8.77 62.50 16.26	33 14.47 62.26 26.83	15 6.58 45.45 12.20	11 4.82 45.83 8.94	6 2.63 37.50 4.88	20 8.77 52.63 16.26	123 53.95
	32 14.04	32 14.04	53 23.25	33 14.47	24 10.53	16 7.02	38 16.67	228

Chi-squared values

Test	Chi-squared	Prob>ChiSq
Likelihood Ratio	5.878	0.4370
Pearson	5.849	**0.4403**

Contingency analysis of the association between gender and number of conferences these dentists attended over the last 2 years did not produce statistical significance (χ^2, Pearson's, p=0.4403).

Table 8.6-9 Contingency analysis of the question (How many practical (Hands on) courses have you attended in the last two years?) by gender

Count Col % Row %	0	1	2	3	4	5	5+	
Male	29 40.28 27.62	36 60.00 34.29	17 35.42 16.19	8 38.10 7.62	8 61.54 7.62	1 33.33 0.95	6 54.55 5.71	105
Fem	43 59.72 34.96	24 40.00 19.51	31 64.58 25.20	13 61.90 10.57	5 38.46 4.07	2 66.67 1.63	5 45.45 4.07	123
	72	60	48	21	13	3	11	228

Chi Square values

Test	Chi-squared	Prob>ChiSq
Likelihood Ratio	10.208	0.1162
Pearson	10.155	**0.1183**

Contingency analysis of the association between gender and number of hands on courses these dentists attended over the last 2 years did not produce statistical significance (χ^2, Pearson's, p=0.1183).

Table 8.6-10 Contingency analysis of the question (How many days did you devote last year to continuous education/ further professional development?) by gender

Count Col % Row %	0	1-5	5-10	10+	
Male	4 30.77 3.81	57 46.34 54.29	25 50.00 23.81	19 45.24 18.10	105
Female	9 69.23 7.32	66 53.66 53.66	25 50.00 20.33	23 54.76 18.70	123
	13	123	50	42	228

Chi-squared values

Test	Chi-squared	Prob>ChiSq
Likelihood Ratio	1.592	0.6613
Pearson	1.551	**0.6705**

Contingency analysis of the association between gender and number of days these dentists devoted to continuous education over the last year did not produce statistical significance (χ^2, Pearson's, p=0.6705).

Table 8.6-11 Contingency analysis of the question (Do you currently subscribe to a dental /medical journal?) by age group

Count Col % Row %	No	Yes	
25-29	39 29.55 60.94	25 26.04 39.06	64
30-34	59 44.70 59.60	40 41.67 40.40	99
35-39	32 24.24 54.24	27 28.13 45.76	59
40+	2 1.52 33.33	4 4.17 66.67	6
	132	96	228

Chi-squared values

Test	Chi-squared	Prob>ChiSq
Likelihood Ratio	2.152	0.5414
Pearson	2.169	**0.5380**

Contingency analysis of the association between age and the number of subscriptions to scientific journals did not produce statistical significance (χ^2, Pearson's, p=0.5380).

Table 8.6-12 Contingency analysis of the question (Do you have on-line access to journals via your practice or hospital settings?) by age group

Count Col % Row %	No	Yes	
25-29	26 30.59 40.63	38 26.57 59.38	64
30-34	35 41.18 35.35	64 44.76 64.65	99
35-39	21 24.71 35.59	38 26.57 64.41	59
40+	3 3.53 50.00	3 2.10 50.00	6
	85	143	228

Chi-squared values

Test	Chi-squared	Prob>ChiSq
Likelihood Ratio	0.935	0.8170
Pearson	0.950	**0.8133**

Contingency analysis of the association between age and on-line access to journals did not produce statistical significance (χ^2, Pearson's, p=0.8133).

Table 8.6-13 Contingency analysis of the question (Are you a member of a dental association/ federation /society/ academy etc.?) by age group

Count Col % Row %	No	Yes	
25-29	25 33.78 39.06	39 25.49 60.94	64
30-34	33 44.59 33.33	66 42.48 65.66	99
35-39	15 20.27 25.42	44 28.76 74.58	59
40+	1 1.35 16.67	5 3.27 83.33	6
	74	154	228

Chi-squared values

Test	Chi-squared	Prob>ChiSq
Likelihood Ratio	3.427	0.330
Pearson	3.322	**0.345**

Contingency analysis of the association between age and being a member of a dental society etc., did not produce statistical significance (χ^2, Pearson's, p=0.345).

Table 8.6-14 Contingency analysis of the question (How many conferences have you attended in the last 2 years?) by age group

Count Col % Row %	0	1	2	3	4	5	5+	
25-29	6 18.75 9.38	11 34.38 17.19	16 30.19 25.00	12 36.36 18.75	5 20.83 7.81	2 12.50 3.13	12 31.58 18.75	64
30-34	16 50.00 16.16	13 40.63 13.13	25 47.17 25.25	9 27.27 9.09	11 45.83 11.11	7 43.75 7.07	18 47.37 18.18	99
35-39	10 31.25 16.95	6 18.75 10.17	12 22.64 20.34	11 33.33 18.64	6 25.00 10.17	6 37.50 10.17	8 21.05 13.56	59
40+	0 0.00 0.00	2 6.25 33.33	0 0.00 0.00	1 3.03 16.67	2 8.33 33.33	1 6.25 16.67	0 0.00 0.00	6
	32	32	53	33	24	16	38	228

Chi-squared values

Test	Chi-squared	Prob>ChiSq
Likelihood Ratio	20.838	0.2877
Pearson	18.735	**0.4083**

Contingency analysis of the association between age and number of conferences these dentists attended over the last 2 years did not produce statistical significance (χ^2, Pearson's, p=0.4083).

Table 8.6-15 Contingency analysis of the question (How many practical (Hands on) courses have you attended in the last two years?) by age group

Count Col % Row %	0	1	2	3	4	5	5+	
25-29	18 25.00 28.13	18 30.00 28.13	17 35.42 26.56	5 23.81 7.81	2 15.38 3.13	2 66.67 3.13	2 18.18 3.13	64
30-34	34 47.22 34.34	26 43.33 26.26	15 31.25 15.15	10 47.62 10.10	8 61.54 8.08	1 33.33 1.01	5 45.45 5.05	99
35-39	19 26.39 32.20	14 23.33 23.73	15 31.25 25.42	5 23.81 8.47	3 23.08 5.08	0 0.00 0.00	3 27.27 5.08	59
40+	1 1.39 16.67	2 3.33 33.33	1 2.08 16.67	1 4.76 16.67	0 0.00 0.00	0 0.00 0.00	1 9.09 16.67	6
	72	60	48	21	13	3	11	228

Chi-squared values

Test	Chi-squared	Prob>ChiSq
Likelihood Ratio	12.054	0.8444
Pearson	11.795	**0.8576**

Contingency analysis of the association between age and number of hands on courses these dentists attended over the last 2 years did not produce statistical significance (χ^2, Pearson's, p=0.8576).

Table 8.6-16 Contingency analysis of the question (How many days did you devote last year to continuous education/ further professional development?) by age group

Count Col % Row %	0	1-5	5-10	10+	
25-29	5 38.46 7.81	35 28.46 54.69	13 26.00 20.31	11 26.19 17.19	64
30-34	5 38.46 5.05	54 43.90 54.55	19 38.00 19.19	21 50.00 21.21	99
35-39	3 23.08 5.08	31 25.20 52.54	16 32.00 27.12	9 21.43 15.25	59
40+	0 0.00 0.00	3 2.44 50.00	2 4.00 33.33	1 2.38 16.67	6
	13	123	50	42	228

Chi-squared values

Test	Chi-squared	Prob>ChiSq
Likelihood Ratio	3.518	0.9402
Pearson	3.305	**0.9510**

Contingency analysis of the association between age and number of days these dentists devoted to continuous education over the last year did not produce statistical significance (χ^2, Pearson's, p=0.9510).

Table 8.6-17 Contingency analysis of the question (Do you currently subscribe to a dental /medical journal?) by marital status

Count Total % Col % Row %	No	Yes	
Married	60 26.32 45.45 58.82	42 18.42 43.75 41.18	102 44.74
Single	71 31.14 53.79 57.26	53 23.25 55.21 42.74	124 54.39
Divorced	1 0.44 0.76 100.00	0 0.00 0.00 0.00	1 0.44
Separ	0 0.00 0.00 0.00	1 0.44 1.04 100.00	1 0.44
	132 57.89	96 42.11	228

Chi-squared values

Test	Chi-squared	Prob>ChiSq
Likelihood Ratio	2.880	0.4105
Pearson	2.159	**0.5401**

Contingency analysis of the association between marital status and the number of subscriptions to scientific journals did not produce statistical significance (χ^2, Pearson's, p=0.5401).

Table 8.6-18 Contingency analysis of the question (Do you have on-line access to journals via your practice or hospital settings?) by marital status

Count Total % Col % Row %	No	Yes	
Single	42 18.42 49.41 41.18	60 26.32 41.96 58.82	102 44.74
Married	41 17.98 48.24 33.06	83 36.40 58.04 66.94	124 54.39
Divorced	1 0.44 1.18 100.00	0 0.00 0.00 0.00	1 0.44
Separ	1 0.44 1.18 100.00	0 0.00 0.00 0.00	1 0.44
	85 37.28	143 62.72	228

Chi-squared values

Test	Chi-squared	Prob>ChiSq
Likelihood Ratio	5.559	0.1351
Pearson	4.969	**0.1740**

Contingency analysis of the association between marital status and on-line access to journals did not produce statistical significance (χ^2, Pearson's, p=0.1740).

Table 8.6-19 Contingency analysis of the question (Are you a member of a dental association/ federation /society/ academy etc?) by marital status

Count Col % Row %	No	Yes	
Single	26 35.1 25.5	76 49.4 74.5	102
Married	47 63.5 37.9	77 50.0 62.1	124
Divorc	1 1.4 100.00	0 0.00 0.00	1
Separ	0 0.00 0.00	1 0.6 100.00	1
	74	153	228

Chi-squared values

Test	Chi-squared	Prob>ChiSq
Likelihood Ratio	7.027	0.071
Pearson	6.498	**0.090**

Contingency analysis of the association between marital status and being a member of a dental society etc., did not produce statistical significance (χ^2, Pearson's, p=0.090).

Table 8.6-20 Contingency analysis of the question (How many conferences have you attended in the last 2 years?) by marital status

Count Col % Row %	0	1	2	3	4	5	5+	
Sing	18 56.25 17.65	15 46.88 14.71	25 47.17 24.51	9 27.27 8.82	11 45.83 10.78	9 56.25 8.82	15 39.47 14.71	102
Marr	14 43.75 11.29	17 53.13 13.71	27 50.94 21.77	24 72.73 19.35	13 54.17 10.48	7 43.75 5.65	22 57.89 17.74	124
Divo	0 0.00 0.00	0 0.00 0.00	1 1.89 100.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	1
Sep	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	1 2.63 100.00	1
	32	32	53	33	24	16	38	228

Chi-squared values

Test	Chi-squared	Prob>ChiSq
Likelihood Ratio	13.913	0.7348
Pearson	15.569	**0.6226**

Contingency analysis of the association between marital status and number of conferences these dentists attended over the last 2 years did not produce statistical significance (χ^2, Pearson's, p=0.6226).

Table 8.6-21 Contingency analysis of the question (How many practical (hands-on) courses have you attended in the last two years?) by marital status

Count Col % Row %	0	1	2	3	4	5	5+	
Single	36 50.00 35.29	22 36.67 21.57	21 43.75 20.59	10 47.62 9.80	5 38.46 4.90	1 33.33 0.98	7 63.64 6.86	102
Marr	35 48.61 28.23	38 63.33 30.65	26 54.17 20.97	11 52.38 8.87	8 61.54 6.45	2 66.67 1.61	4 36.36 3.23	124
Divor	1 1.39 100.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	1
Separ	0 0.00 0.00	0 0.00 0.00	1 2.08 100.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	1
	72	60	48	21	13	3	11	228

Chi-squared values

Test	Chi-squared	Prob>ChiSq
Likelihood Ratio	10.074	0.9295
Pearson	10.568	**0.9118**

Contingency analysis of the association between marital status and number of hands-on courses these dentists attended over the last 2 years did not produce statistical significance (χ^2, Pearson's, p=0.9118).

Table 8.6-22 Contingency analysis of the question (How many days did you devote last year to continuous education/ further professional development?) by marital status

Count Col % Row %	0	1-5	5-10	10+	
Single	6 46.15 5.88	57 46.34 55.88	22 44.00 21.57	17 40.48 16.67	102
Married	7 53.85 5.65	64 52.03 51.61	28 56.00 22.58	25 59.52 20.16	124
Divor	0 0.00 0.00	1 0.81 100.00	0 0.00 0.00	0 0.00 0.00	1
Separ	0 0.00 0.00	1 0.81 100.00	0 0.00 0.00	0 0.00 0.00	1
	13	123	50	42	228

Chi-squared values

Test	Chi-squared	Prob>ChiSq
Likelihood Ratio	3.076	0.9612
Pearson	2.314	**0.9855**

Contingency analysis of the association between marital status and number of days these dentists devoted to continuous education over the last year did not produce statistical significance (χ^2, Pearson's, p=0.9855).

Table 8.6-23 Contingency analysis of the question (Do you currently subscribe to a dental /medical journal?) by presence of children in the family

Count Col % Row %	No	Yes	
No ch	93 70.45 56.02	73 76.04 43.98	166
Yes ch	39 29.55 62.90	23 23.96 37.10	62
	132	96	228

Chi-squared values

Test	Chi-squared	Prob>ChiSq
Likelihood Ratio	0.884	0.3472
Pearson	0.876	**0.3492**

Contingency analysis of the association between presence of children in the family and the number of subscriptions to scientific journals did not produce statistical significance (χ^2, Pearson's, p=0.3492).

Table 8.6-24 Contingency analysis of the question (Do you have on-line access to journals via your practice or hospital settings?) by presence of children in the family

Count Col % Row %	No	Yes	
No ch	58 68.24 34.94	108 75.52 65.06	166
Yes ch	27 31.76 43.55	35 24.48 56.45	62
	85	143	228

Chi-squared values

Test	Chi-squared	Prob>ChiSq
Likelihood Ratio	1.414	0.2344
Pearson	1.431	**0.2317**

Contingency analysis of the association between presence of children in the family and on-line access to journals did not produce statistical significance (χ^2, Pearson's, p=0.2317).

Table 8.6-25 Contingency analysis of the question (Are you a member of a dental association/ federation /society/ academy etc.?) by presence of children in the family

Count Col % Row %	No	Yes	
No ch	55 74.3 33.1	111 72.1 66.9	166
Yes ch	19 25.7 30.6	43 27.9 69.	62
	74	154	228

Chi-squared values

Test	Chi-squared	Prob>ChiSq
Likelihood Ratio	0.128	0.720
Pearson	0.127	**0.721**

Contingency analysis of the association between presence of children in the family and being a member of a dental society etc., did not produce statistical significance (χ^2, Pearson's, p=0.721).

Table 8.6-26 Contingency analysis of the question (How many conferences have you attended in the last 2 years?) by presence of children in the family

Count Col % Row %	0	1	2	3	4	5	5+	
No ch	19 59.38 11.45	21 65.63 12.65	37 69.81 22.29	26 78.79 15.66	17 70.83 10.24	14 87.50 8.43	32 84.21 19.28	166
Yes ch	13 40.63 20.97	11 34.38 17.74	16 30.19 25.81	7 21.21 11.29	7 29.17 11.29	2 12.50 3.23	6 15.79 9.68	62
	32	32	53	33	24	16	38	228

Chi-squared values

Test	Chi-squared	Prob>ChiSq
Likelihood Ratio	9.218	0.1617
Pearson	8.874	**0.1808**

Contingency analysis of the association between presence of children in the family and number of conferences these dentists attended over the last 2 years did not produce statistical significance (χ^2, Pearson's, p=0.1808).

Table 8.6-27 Contingency analysis of the question (How many practical (Hands on) courses have you attended in the last two years?) by presence of children in the family

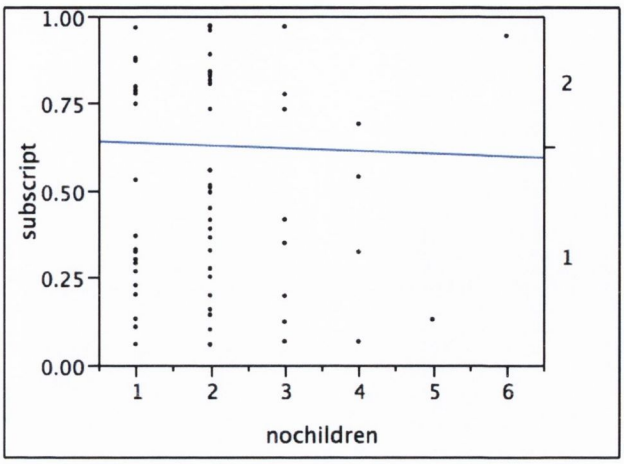
Count Col % Row %	0	1	2	3	4	5	6	
1	49 68.06 29.52	48 80.00 28.92	32 66.67 19.28	17 80.95 10.24	9 69.23 5.42	3 100.00 1.81	8 72.73 4.82	166
2	23 31.94 37.10	12 20.00 19.35	16 33.33 25.81	4 19.05 6.45	4 30.77 6.45	0 0.00 0.00	3 27.27 4.84	62
	72	60	48	21	13	3	11	228

Chi-squared values

Test	Chi-squared	Prob>ChiSq
Likelihood Ratio	6.085	0.4137
Pearson	5.211	**0.5170**

Contingency analysis of the association between presence of children in the family and number of hands on courses these dentists attended over the last 2 years did not produce statistical significance (χ^2, Pearson's, p=0.5170).

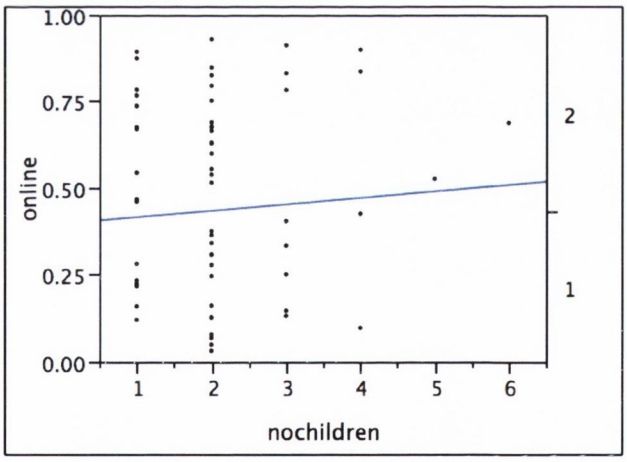
Figure 8.6-1 Logistic fit of (do you currently subscribe to a dental /medical journal?) by number of children



Parameter estimates

Term	Estimate	Std Error	Chi-squared	Prob>ChiSq
Intercept	0.5952413	0.5815162	1.05	0.3060
nochildren	-0.0324672	0.2501658	0.02	0.8967

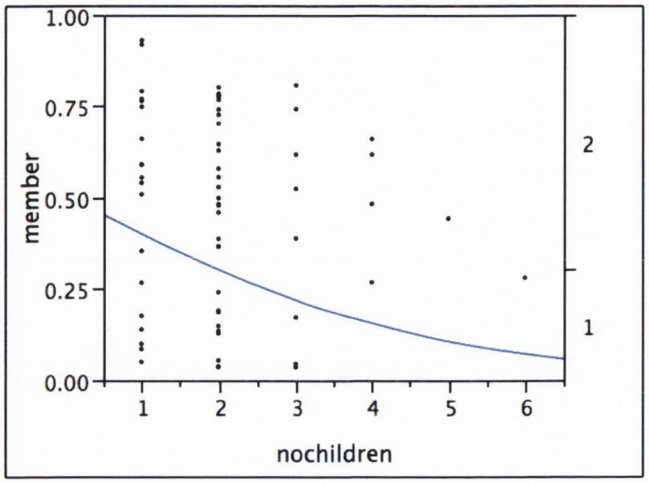
Figure 8.6-2 Logistic fit of (do you have on-line access to journals via your practice or hospital settings?) by number of children



Parameter estimates

Term	Estimate	Std Error	Chi-squared	Prob>ChiSq
Intercept	-0.4151423	0.5676467	0.53	0.4646
nochildren	0.07521743	0.2443284	0.09	0.7582

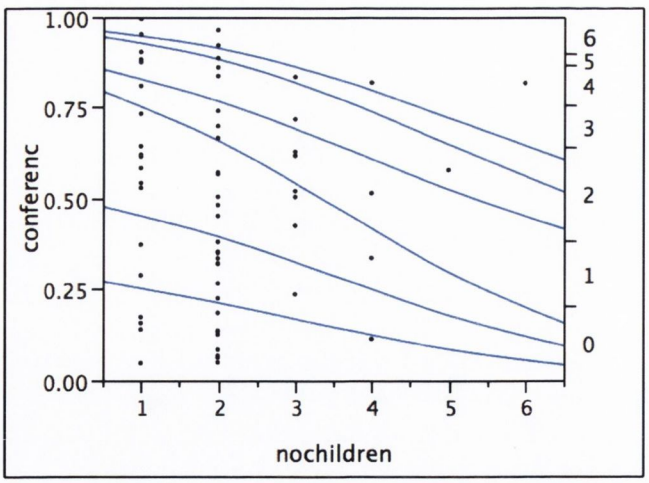
Figure 8.6-3 Logistic fit of (are you a member of a dental association/ federation /society/ academy etc.?) by number of children



Parameter estimates

Term		Estimate	Std Error	Chi-squared	Prob>ChiSq
Intercept[1]	Unstable	12.7068283	251.4357	0.00	0.9597
nochildren[1]		-0.1987983	116.3612	0.00	0.9986
Intercept[2]	Unstable	12.6768376	251.43535	0.00	0.9598
nochildren[2]		0.231244	116.36096	0.00	0.9984

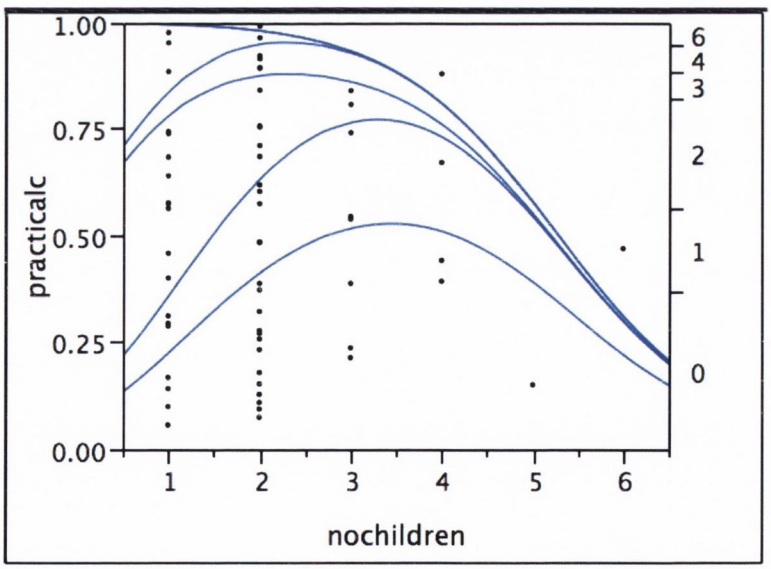
Figure 8.6-4 Logistic fit of (how many conferences have you attended in the last 2 years?) by number of children



Parameter estimates

Term	Estimate	Std Error	Chi-squared	Prob>ChiSq
Intercept[0]	2.30111586	1.1651945	3.90	0.0483
nochildren[0]	-0.6963535	0.4668145	2.23	0.1358
Intercept[1]	1.97994483	1.1868188	2.78	0.0953
nochildren[1]	-0.6142507	0.4708849	1.70	0.1921
Intercept[2]	2.43693294	1.1244551	4.70	**0.0302**
nochildren[2]	-0.6577492	0.4388278	2.25	0.1339
Intercept[3]	0.52202916	1.2397843	0.18	0.6737
nochildren[3]	-0.1446137	0.4347762	0.11	0.7394
Intercept[4]	1.02720359	1.2635186	0.66	0.4162
nochildren[4]	-0.3663272	0.4775878	0.59	0.4431
Intercept[5]	-0.8447144	1.8144806	0.22	0.6415
nochildren[5]	-0.0983165	0.6382587	0.02	0.8776

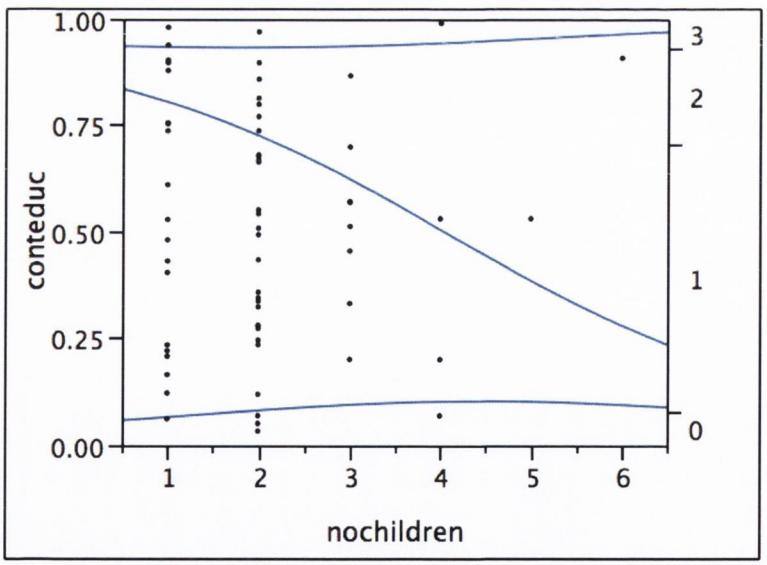
Figure 8.6-5 Logistic fit of how many practical (hands on) courses have you attended in the last two years? by number of children



Parameter estimates

Term		Estimate	Std Error	Chi-squared	Prob>ChiSq
Intercept[0]		5.2306372	1.9576572	7.14	0.0075
nochildren[0]		-1.0606589	0.5283561	4.03	0.0447
Intercept[1]		4.80927219	2.0408836	5.55	0.0184
nochildren[1]		-1.1642423	0.5843886	3.97	0.0463
Intercept[2]		7.01889315	2.1214383	10.95	0.0009
nochildren[2]		-2.2171122	0.706635	9.84	0.0017
Intercept[3]		4.15620885	2.3293144	3.18	0.0744
nochildren[3]		-1.3783966	0.7888862	3.05	0.0806
Intercept[4]		7.1080789	2.5129409	8.00	0.0047
nochildren[4]		-3.2786777	1.2634425	6.73	0.0095
Intercept[5]	Unstable	-5.380844	176.81196	0.00	0.9757
nochildren[5]		-1.5209817	85.715916	0.00	0.9858

Figure 8.6-6 Logistic fit of (how many days did you devote last year to continuous education/ further professional development?) by number of children



Parameter estimates

Term	Estimate	Std Error	Chi-squared	Prob>ChiSq
Intercept[0]	-0.1807111	1.5410359	0.01	0.9066
nochildren[0]	0.19269939	0.6673452	0.08	0.7728
Intercept[1]	2.57529084	1.2218635	4.44	0.0351
nochildren[1]	-0.1541048	0.5555058	0.08	0.7815
Intercept[2]	0.22541005	1.3212365	0.03	0.8645
nochildren[2]	0.45526104	0.5706773	0.64	0.4250

Potentially interesting – needs follow-up

There seems to be some complex relationship between number of days devoted to continuous education and number of children.

Table 8.6-28 Contingency analysis of the pulpotomy question by curriculum

Count Col % Row %	Wrong	Correct	
Trad	25 31.65 32.89	51 34.23 67.11	76
Hybr	27 34.18 35.53	49 32.89 64.47	76
PBL	27 34.18 35.53	49 32.89 64.47	76
	79	149	228

Chi-squared values

Test	Chi-squared	Prob>ChiSq
Pearson	0.155	**0.9254**

No significant association

Table 8.6-29 Contingency analysis of the acute pain question by curriculum

Count Col % Row %	Wrong	Correct	
Trad	1 33.33 1.32	75 33.33 98.68	76
Hybr	2 66.67 2.63	74 32.89 97.37	76
PBL	0 0.00 0.00	76 33.78 100.00	76
	3	225	228

Chi-squared values

Test	Chi-squared	Prob>ChiSq
Pearson	2.027	**0.3630**

No significant association

Table 8.6-30 Contingency analysis of the bitewing question by curriculum

Count Col % Row %	Wrong	Correct	
Trad	24 30.38 31.58	52 34.90 68.42	76
Hybr	25 31.65 32.89	51 34.23 67.11	76
PBL	30 37.97 39.47	46 30.87 60.53	76
	79	149	228

Chi-squared values

Test	Chi-squared	Prob>ChiSq
Pearson	1.201	**0.5486**

No significant association

Table 8.6-31 Contingency analysis of replantation question by curriculum

Count Col % Row %	Wrong	Correct	
Trad	71 34.13 93.42	5 25.00 6.58	76
Hybr	66 31.73 86.84	10 50.00 13.16	76
PBL	71 34.13 93.42	5 25.00 6.58	76
	208	20	228

Chi-squared values

Test	Chi-squared	Prob>ChiSq
Pearson	2.740	**0.2541**

No significant association

Table 8.6-32 Contingency analysis of the iv question by gender

Count Col % Row %	Wrong	Correct1	
Male	77 50.33 73.33	28 37.33 26.67	105
Fem	76 49.67 61.79	47 62.67 38.21	123
	153	75	228

Chi-squared values

Test	Chi-squared	Prob>ChiSq
Pearson	3.420	**0.0644**

No significant association

Table 8.6-33 Contingency analysis of the pulpotomy question by gender

Count Col % Row %	Wrong	Correct	
Male	38 48.10 36.19	67 44.97 63.81	105
Fem	41 51.90 33.33	82 55.03 66.67	123
	79	149	228

Chi-squared values

Test	Chi-squared	Prob>ChiSq
Pearson	0.204	**0.6513**

No significant association

Table 8.6-34 Contingency analysis of the acute pain question by gender

Count Col % Row %	Wrong	Correct	
Male	3 100.00 2.86	102 45.33 97.14	105
Fem	0 0.00 0.00	123 54.67 100.00	123
	3	225	228

Chi-squared values

Test	Chi-squared	Prob>ChiSq
Pearson	3.561	**0.0591**

No Significant association

Table 8.6-35 Contingency analysis of the bitewing question by gender

Count Col % Row %	Wrong	Correct	
Male	37 46.84 35.24	68 45.64 64.76	105
Fem	42 53.16 34.15	81 54.36 65.85	123
	79	149	228

Chi-squared values

Test	Chi-squared	Prob>ChiSq
Pearson	0.030	**0.8629**

No significant association

Table 8.6-36 Contingency analysis of the replantation question by gender

Count Col % Row %	Wrong	Correct	
Male	97 46.63 92.38	8 40.00 7.62	105
Fem	111 53.37 90.24	12 60.00 9.76	123
	208	20	228

Chi-squared values

Test	Chi-squared	Prob>ChiSq
Pearson	0.323	**0.5696**

No significant association

Table 8.6-37 Contingency analysis of the iv question by age-group

Count Col % Row %	Wrong	Correct	
25-29	47 30.72 73.44	17 22.67 26.56	64
30-34	60 39.22 60.61	39 52.00 39.39	99
35-39	41 26.80 69.49	18 24.00 30.51	59
40+	5 3.27 83.33	1 1.33 16.67	6
	153	75	228

Chi-squared values

Test	**Chi-squared**	**Prob>ChiSq**
Pearson	3.925	**0.2697**

No significant association

Table 8.6-38 Contingency analysis of the pulpotomy question by age-group.

Count Col % Row %	Wrong	Correct	
25-29	23 29.11 35.94	41 27.52 64.06	64
30-34	35 44.30 35.35	64 42.95 64.65	99
35-39	19 24.05 32.20	40 26.85 67.80	59
40+	2 2.53 33.33	4 2.68 66.67	6
	79	149	228

Chi-squared values

Test	Chi-squared	Prob>ChiSq
Pearson	0.229	0.9728

No significant association

Table 8.6-39 Contingency analysis of the acute pain question by age-group

Count Col % Row %	Wrong	Correct	
25-29	0 0.00 0.00	64 28.44 100.00	64
30-34	1 33.33 1.01	98 43.56 98.99	99
35-39	2 66.67 3.39	57 25.33 96.61	59
40+	0 0.00 0.00	6 2.67 100.00	6
	3	225	228

Chi-squared values

Test	Chi-squared	Prob>ChiSq
Pearson	2.959	**0.3980**

No significant association

Table 8.6-40 Contingency analysis of the bitewing question by age-group

Count Col % Row %	Wrong	Correct	
25-29	25 31.65 39.06	39 26.17 60.94	64
30-34	33 41.77 33.33	66 44.30 66.67	99
35-39	16 20.25 27.12	43 28.86 72.88	59
40+	5 6.33 83.33	1 0.67 16.67	6
	79	149	228

Chi-squared values

Test	Chi-squared	Prob>ChiSq
Pearson	8.384	**0.0387**

Significant association

Table 8.6-41 Contingency analysis of the replantation question by age-group

Count Col % Row %	Wrong	Correct	
25-29	60 28.85 93.75	4 20.00 6.25	64
30-34	88 42.31 88.89	11 55.00 11.11	99
35-39	54 25.96 91.53	5 25.00 8.47	59
40+	6 2.88 100.00	0 0.00 0.00	6
	208	20	228

Chi-squared values

Test	Chi-squared	Prob>ChiSq
Pearson	1.769	**0.6217**

No significant association

Table 8.6-42 Contingency analysis of the iv question by marital status

Count Col % Row %	Wrong	Correct	
Sing	66 43.14 64.71	36 48.00 35.29	102
Marr	85 55.56 68.55	39 52.00 31.45	124
Div	1 0.65 100.00	0 0.00 0.00	1
Sep	1 0.65 100.00	0 0.00 0.00	1
	153	75	228

Chi-squared values

Test	Chi-squared	Prob>ChiSq
Pearson	1.363	**0.7141**

No significant association

Table 8.6-43 Contingency analysis of the pulpotomy question by marital status

Count Col % Row %	Wrong	Correct	
Sing	42 53.16 41.18	60 40.27 58.82	102
Marr	37 46.84 29.84	87 58.39 70.16	124
Div	0 0.00 0.00	1 0.67 100.00	1
Sep	0 0.00 0.00	1 0.67 100.00	1
	79	149	228

Chi-squared values

Test	Chi-squared	Prob>ChiSq
Pearson	4.247	**0.2360**

No significant association

Table 8.6-44 Contingency analysis of the acute pain question by marital status

Count Col % Row %	Wrong	Correct	
Sing	2 66.67 1.96	100 44.44 98.04	102
Marr	1 33.33 0.81	123 54.67 99.19	124
Div	0 0.00 0.00	1 0.44 100.00	1
Sep	0 0.00 0.00	1 0.44 100.00	1
	3	225	228

Chi-squared values

Test	Chi-squared	Prob>ChiSq
Pearson	0.601	**0.8962**

No significant association

Table 8.6-45 Contingency analysis of the bitewing question by marital status

Count Col % Row %	Wrong	Correct	
Sing	29 36.71 28.43	73 48.99 71.57	102
Marr	49 62.03 39.52	75 50.34 60.48	124
Div	1 1.27 100.00	0 0.00 0.00	1
Sep	0 0.00 0.00	1 0.67 100.00	1
	79	149	228

Chi-squared values

Test	Chi-squared	Prob>ChiSq
Pearson	5.455	0.1414

No significant association

Table 8.6-46 Contingency analysis of the replantation question by marital status

Count Col % Row %	Wrong	Correct	
1	91 43.75 89.22	11 55.00 10.78	102
2	115 55.29 92.74	9 45.00 7.26	124
3	1 0.48 100.00	0 0.00 0.00	1
4	1 0.48 100.00	0 0.00 0.00	1
	208	20	228

Chi-squared values

Test	Chi-squared	Prob>ChiSq
Pearson	1.064	**0.7859**

No significant association

Table 8.6-47 Contingency analysis of the iv question by presence of children in the family.

Count Col % Row %	Wrong	Correct	
No ch	113 73.86 68.07	53 70.67 31.93	166
Yes ch	40 26.14 64.52	22 29.33 35.48	62
	153	75	228

Chi-squared values

Test	Chi-squared	Prob>ChiSq
Pearson	0.259	**0.6111**

No significant association

Table 8.6-48 Contingency analysis of the acute pain question by the presence of children in the family

Count Col % Row %	Wrong	Correct	
No ch	2 66.67 1.20	164 72.89 98.80	166
Yes ch	1 33.33 1.61	61 27.11 98.39	62
	3	225	228

Chi-squared values

Test	Chi-squared	Prob>ChiSq
Pearson	0.058	**0.8099**

No significant association

Table 8.6-49 Contingency analysis of the bitewing question by the presence of children in the family

Count Total % Col % Row %	Wrong	Correct	
No ch	62 27.19 78.48 37.35	104 45.61 69.80 62.65	166 72.81
Yes ch	17 7.46 21.52 27.42	45 19.74 30.20 72.58	62 27.19
	79 34.65	149 65.35	228

Chi-squared values

Test	Chi-squared	Prob>ChiSq
Pearson	1.966	**0.1609**

No significant association

Table 8.6-50 Contingency analysis of the replantation question by the presence of children in the family

Count Col % Row %	Wrong	Correct	
No ch	150 72.12 90.36	16 80.00 9.64	166
Yes ch	58 27.88 93.55	4 20.00 6.45	62
	208	20	228

Chi-squared values

Test	Chi-squared	Prob>ChiSq
Pearson	**0.573**	**0.4491**

Figure 8.6-7 One way analysis of (enjoy/undergraduate course) by curriculum

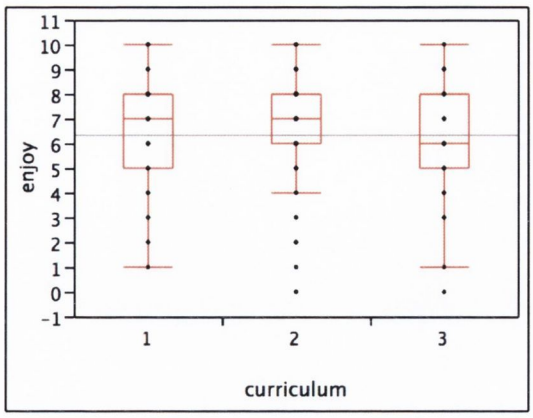


Table 8.6-51 Medians and quantiles of (enjoy/undergraduate course) by curriculum

Level	Min	25%	Median	75%	Max
1=Trad	1	5	7	8	10
2=Hybr	0	6	7	8	10
3=PBL	0	5	6	8	10

Analysis of variance (Kruskal-Wallis) showed no significant differences (p=0.4646).

Figure 8.6-8 One way analysis of (ability to practice) by curriculum

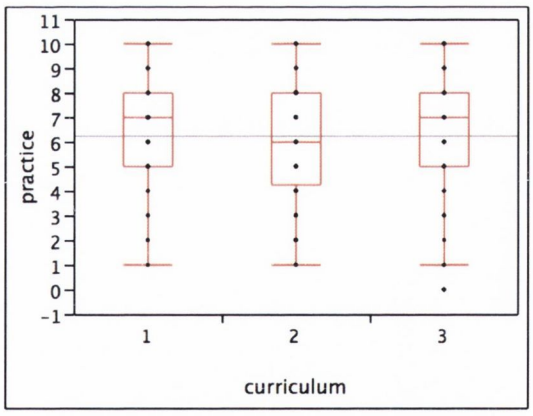


Table 8.6-52 Medians and quantiles of (ability to practice) by curriculum

Level	Minimum	25%	Median	75%	Maximum
1=Trad	1	5	7	8	10
2=Hybr	1	4.25	6	8	10
3=PBL	0	5	7	8	10

Analysis of variance (Kruskal-Wallis) showed no significant differences (p=0.4842).

Figure 8.6-9 One way analysis of (communicate with the patients) by curriculum

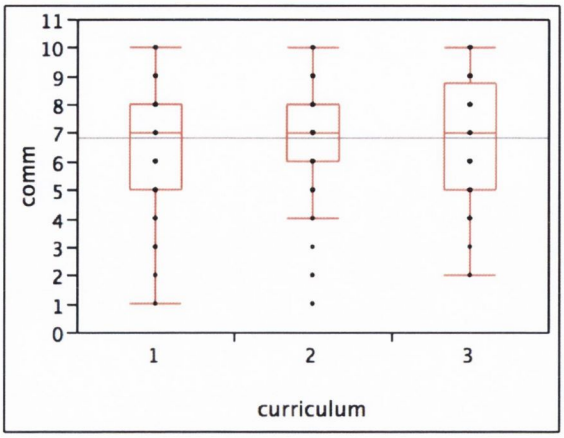


Table 8.6-53 Medians and quantiles of (communicate with the patients) by curriculum

Level	Minimum	25%	Median	75%	Maximum
1=Tra	1	5	7	8	10
2=Hyb	1	6	7	8	10
3=PBL	2	5	7	8.75	10

Analysis of variance (Kruskal-Wallis) showed no significant differences (p=0.4906)

Figure 8.6-10 One way analysis of (keep up to date) by curriculum

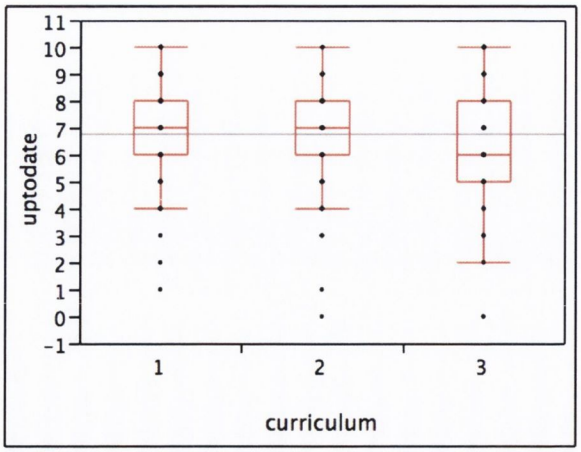


Table 8.6-54 Medians and quantiles of keep up to date) by curriculum

Level	Minimum	25%	Median	75%	Maximum
1=Tra	1	6	7	8	10
2=Hyb	0	6	7	8	10
3=PBL	0	5	6	8	10

Analysis of variance (Kruskal-Wallis) showed no significant differences (p=0.4511)

Figure 8.6-11 One way analysis of (enjoy/undergraduate course) by gender

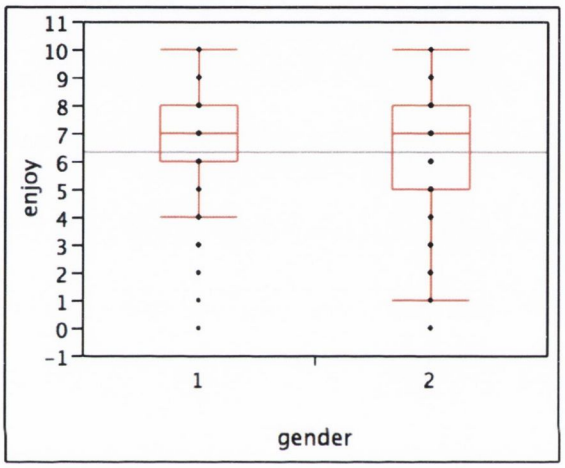


Table 8.6-55 Medians and quantiles of (enjoy/undergraduate course) by gender

Level	Minimum	25%	Median	75%	Maximum
1=Male	0	6	7	8	10
2=Fem	0	5	7	8	10

Analysis of variance (Kruskal-Wallis) showed no significant differences (p=0.1973)

Figure 8.6-12 One way analysis of (ability to practice) by gender

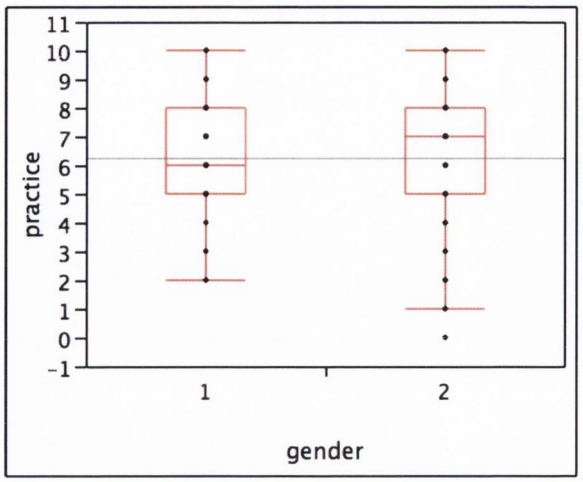


Table 8.6-56 Medians and quantiles of (ability to practice) by gender

Level	Minimum	25%	Median	75%	Maximum
1=Mal	2	5	6	8	10
2=Fem	0	5	7	8	10

Analysis of variance (Kruskal-Wallis) showed no significant differences (p=0.2567)

Figure 8.6-13 One way analysis of (communicate with the patients) by gender

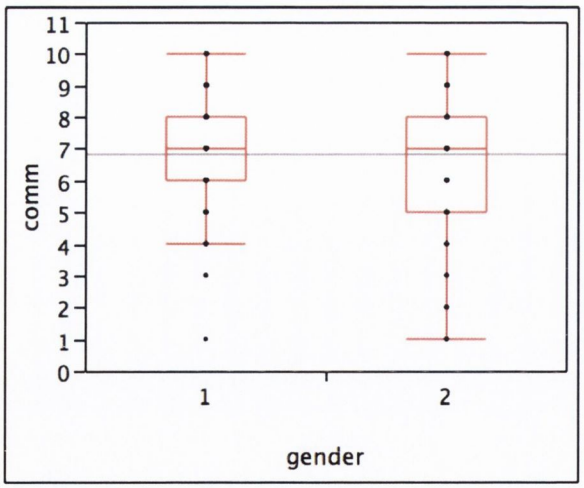


Table 8.6-57 Medians and quantiles of (communicate with the patients) by gender

Level	Minimum	25%	Median	75%	Maximum
1=Male	1	6	7	8	10
2=Fem	1	5	7	8	10

Analysis of variance (Kruskal-Wallis) showed no significant differences (p=0.9188)

Figure 8.6-14 One way analysis of (keep up to date) by gender

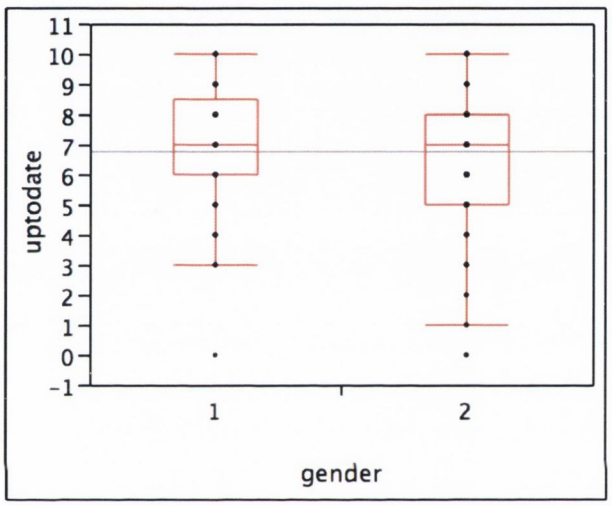


Table 8.6-58 Medians and quantiles of keep up to date) by gender

Level	Minimum	25%	Median	75%	Maximum
1=Male	0	6	7	8.5	10
2=Fem	0	5	7	8	10

Analysis of variance (Kruskal-Wallis) showed no significant differences (p=0.1213)

Figure 8.6-15 One way analysis of (enjoy undergraduate studies) by current position.

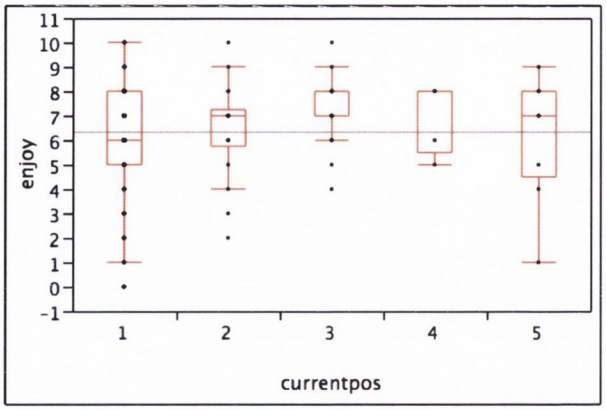


Table 8.6-59 Medians and quantiles of (enjoy/undergraduate course) by current position

Level	Minimum	10%	25%	Median	75%	90%	Maximum
1	0	3	5	6	8	9	10
2	2	2.9	5.75	7	7.25	9.1	10
3	4	5.7	7	7	8	8.3	10
4	5	5	5.5	8	8	8	8
5	1	1	4.5	7	8	9	9

Analysis of variance (Kruskal-Wallis) showed no significant differences (p=0.1375)

Figure 8.6-16 One way analysis of (ability to practice) by current position

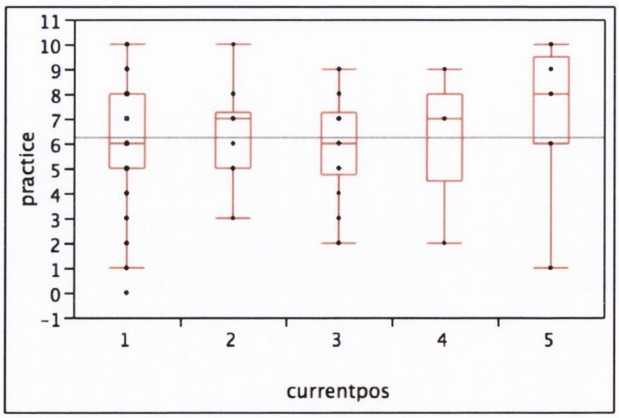


Table 8.6-60 Medians and quantiles of (ability to practice) by current position

Level	Minimum	10%	25%	Median	75%	90%	Maximum
1	0	3	5	6	8	9	10
2	3	4.8	5	7	7.25	8.2	10
3	2	2	4.75	6	7.25	9	9
4	2	2	4.5	7	8	9	9
5	1	1	6	8	9.5	10	10

Analysis of variance (Kruskal-Wallis) showed no significant differences (p=0.3385)

Figure 8.6-17 One way analysis of (communicate with the patients) by current position.

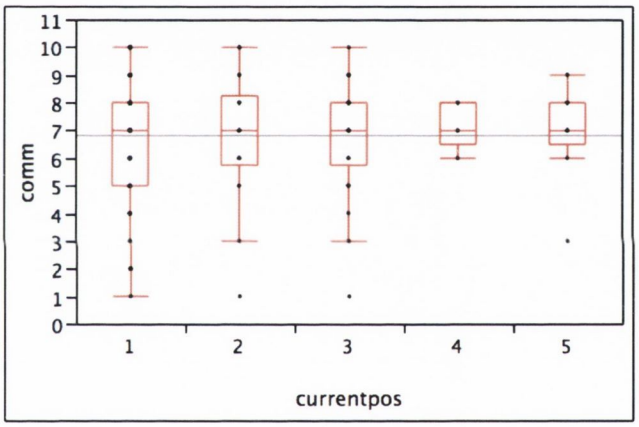


Table 8.6-61 Medians and quantiles of (communicate with the patients) by gender

Level	Minimum	10%	25%	Median	75%	90%	Maximum
1	1	4	5	7	8	9	10
2	1	2.8	5.75	7	8.25	10	10
3	1	3.7	5.75	7	8	9	10
4	6	6	6.5	7	8	8	8
5	3	3	6.5	7	8	9	9

Analysis of variance (Kruskal-Wallis) showed no significant differences (p=0.9766)

Figure 8.6-18 One way analysis of (keep up to date) by current position

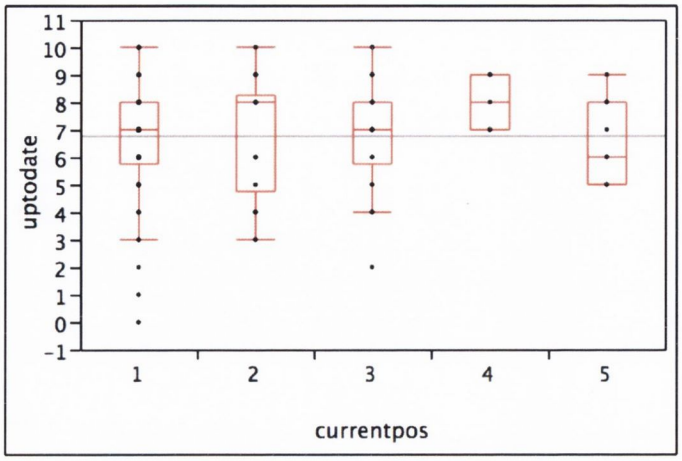


Table 8.6-62 Medians and quantiles of (keep up to date) by current position

Level	Minimum	10%	25%	Median	75%	90%	Maximum
1	0	4	5.75	7	8	9	10
2	3	3	4.75	8	8.25	9.1	10
3	2	4	5.75	7	8	9.3	10
4	7	7	7	8	9	9	9
5	5	5	5	6	8	9	9

Analysis of variance (Kruskal-Wallis) showed no significant differences (p=0.5080)

Table 8.6-63 Contingency analysis of the iv question by current position

Count Col % Row %	Wrong	Correct	
1	114 74.51 67.06	56 74.67 32.94	170 74.56
2	9 5.88 50.00	9 12.00 50.00	18 7.89
3	18 11.76 69.23	8 10.67 30.77	26 11.40
4	4 2.61 80.00	1 1.33 20.00	5 2.19
5	8 5.23 88.89	1 1.33 11.11	9 3.95
	153 67.11	75 32.89	228

Chi-squared values

Test	Chi-squared	Prob>ChiSq
Likelihood Ratio	5.033	0.2840
Pearson	4.751	**0.3139**

No significant association

Table 8.6-64 Contingency analysis of the acute pain question by current position

Count Total % Col % Row %	Wrong	Correct	
1	2 0.88 66.67 1.18	168 73.68 74.67 98.82	170 74.56
2	0 0.00 0.00 0.00	18 7.89 8.00 100.00	18 7.89
3	0 0.00 0.00 0.00	26 11.40 11.56 100.00	26 11.40
4	1 0.44 33.33 20.00	4 1.75 1.78 80.00	5 2.19
5	0 0.00 0.00 0.00	9 3.95 4.00 100.00	9 3.95
	3 1.32	225 98.68	228

Chi-squared values

Test	Chi-squared	Prob>ChiSq
Likelihood Ratio	5.194	0.2680
Pearson	14.175	**0.0068**

Significant association

Figure 8.6-19 Oneway analysis of (ability to practice dentistry) by full or part time work

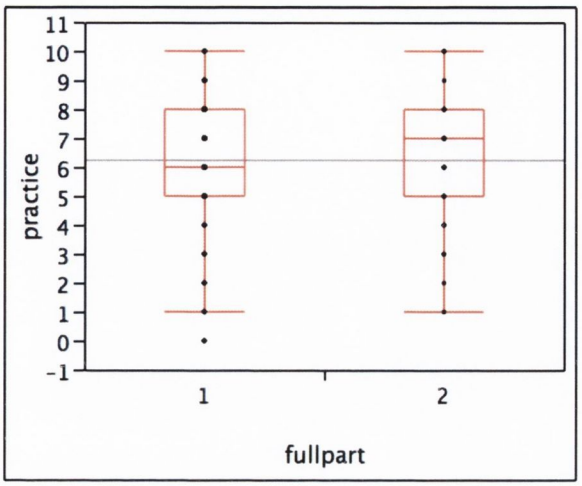


Table 8.6-65 Medians and quantiles of (ability to practice dentistry) by full or part time

Level	Minimum	10%	25%	Median	75%	90%	Maximum
1	0	2.6	5	6	8	9	10
2	1	3.4	5	7	8	8.6	10

Analysis of variance (Kruskal-Wallis) showed no significant differences (p=0.8600)

Figure 8.6-20 One way analysis of (communicate with the patients) by full or part time work

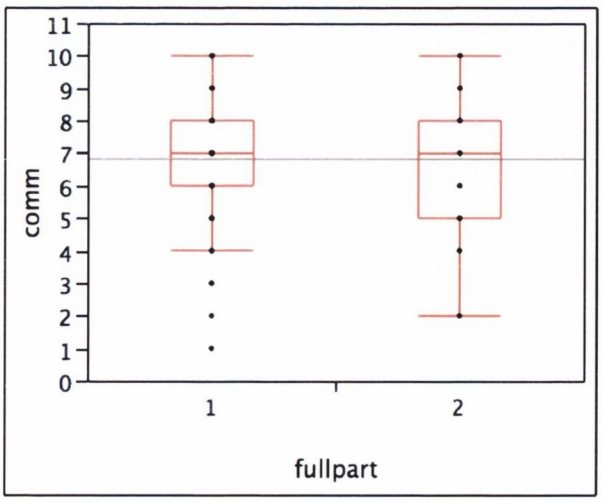


Figure 8.6-21 Medians and quantiles of (communicate with the patient) by full or part time

Level	Minimum	10%	25%	Median	75%	90%	Maximum
1	1	4	6	7	8	9	10
2	2	4	5	7	8	9.6	10

Analysis of variance (Kruskal-Wallis) showed no significant differences (p=0.9513)

Figure 8.6-22 One way analysis of (ability to keep up to date) by full or part time work

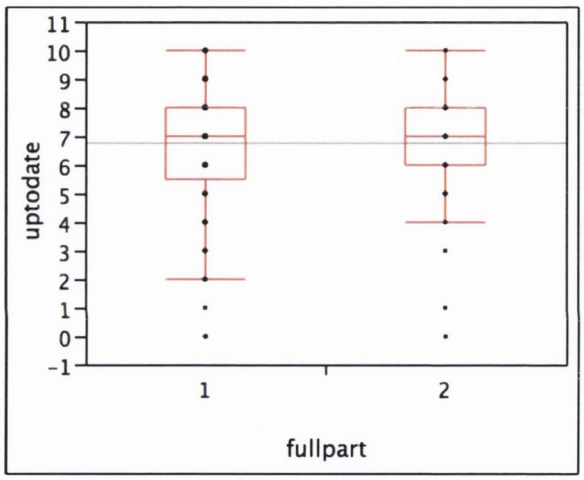


Table 8.6-66 Medians and quantiles of (communicate with the patient) by full or part time

Level	Minimum	10%	25%	Median	75%	90%	Maximum
1	0	4	5.5	7	8	9	10
2	0	4.4	6	7	8	8.6	10

Analysis of variance (Kruskal-Wallis) showed no significant differences (p=0.4065)

Table 8.6-67 Contingency analysis of the iv question by full or part time work

Count Col % Row %	Wrong	Correct	
Full	62 78.48 33.51	123 82.55 66.49	185
Part	17 21.52 39.53	26 17.45 60.47	43
	79	149	228

Chi-squared values

Test	Chi-squared	Prob>ChiSq
Likelihood Ratio	0.550	0.4582
Pearson	0.559	**0.4548**

No significant association

Table 8.6-68 Contingency analysis of the acute pain question by full or part time work

Count Col % Row %	Wrong	Correct	
Full	3 100.00 1.62	182 80.89 98.38	185
Part	0 0.00 0.00	43 19.11 100.00	43
	3	225	228

Chi-squared values

Test	Chi-squared	Prob>ChiSq
Likelihood Ratio	1.263	0.2610
Pearson	0.707	**0.4006**

No significant association

Table 8.6-69 Contingency analysis of the pulpotomy question by full or part time work

Count Col % Row %	Wrong	Correct	
Full	62 78.48 33.51	123 82.55 66.49	185
Part	17 21.52 39.53	26 17.45 60.47	43
	79	149	228

Chi-squared values

Test	Chi-squared	Prob>ChiSq
Likelihood Ratio	0.550	0.4582
Pearson	0.559	**0.4548**

No significant association

Table 8.6-70 Contingency analysis of the bitewing question by full or part time work

Count Col % Row %	Wrong	Correct	
Full	59 74.68 31.89	126 84.56 68.11	185
Part	20 25.32 46.51	23 15.44 53.49	43
	79	149	228

Chi-squared values

Test	Chi-squared	Prob>ChiSq
Likelihood Ratio	3.192	0.0740
Pearson	3.293	**0.0696**

No significant association

Table 8.6-71 Contingency analysis of the replantation question by full or part time work

Count Col % Row %	Wrong	Correct	
Full	170 81.73 91.89	15 75.00 8.11	185
Part	38 18.27 88.37	5 25.00 11.63	43
	208	20	228

Chi-squared values

Test	Chi-squared	Prob>ChiSq
Likelihood Ratio	0.506	0.4771
Pearson	0.540	**0.4624**

No significant association

Figure 8.6-23 One way analysis of (ability to practice dentistry) by working relationship

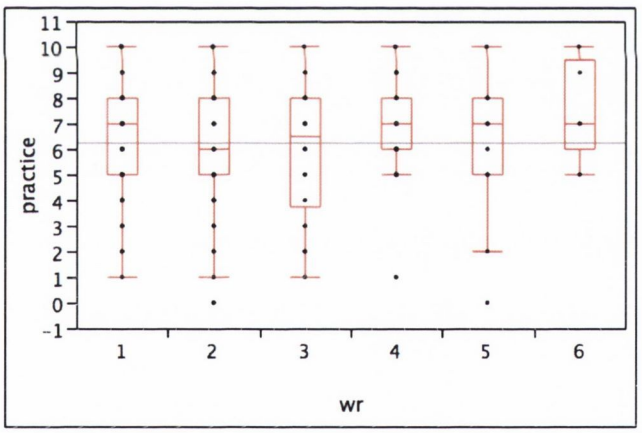


Table 8.6-72 Medians and quantiles of (ability to practice dentistry) by working relationship

Level	Minimum	10%	25%	Median	75%	90%	Maximum
1	1	3	5	7	8	10	10
2	0	2.6	5	6	8	9	10
3	1	2	3.75	6.5	8	9	10
4	1	5	6	7	8	9	10
5	0	2.6	5	7	8	8	10
6	5	5	6	7	9.5	10	10

Analysis of variance (Kruskal-Wallis) showed no significant differences

Figure 8.6-24 One way analysis of (ability to communicate with the patient) by working relationship

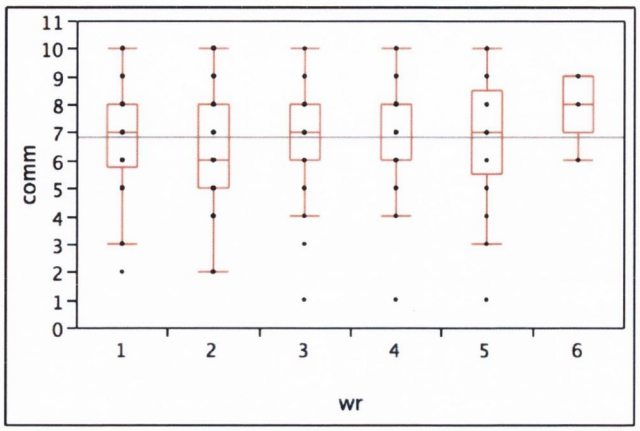


Table 8.6-73 Medians and quantiles of (ability to communicate with the patient) by working relationship

Level	Minimum	10%	25%	Median	75%	90%	Maximum
1	2	5	5.75	7	8	9	10
2	2	4	5	6	8	9	10
3	1	3.7	6	7	8	9	10
4	1	5	6	8	8	9	10
5	1	3.2	5.5	7	8.5	9.8	10
6	6	6	7	8	9	9	9

Analysis of variance (Kruskal-Wallis) showed no significant differences (p=0.3812)

Figure 8.6-25 One way analysis of (ability to keep up to date) by working relationship

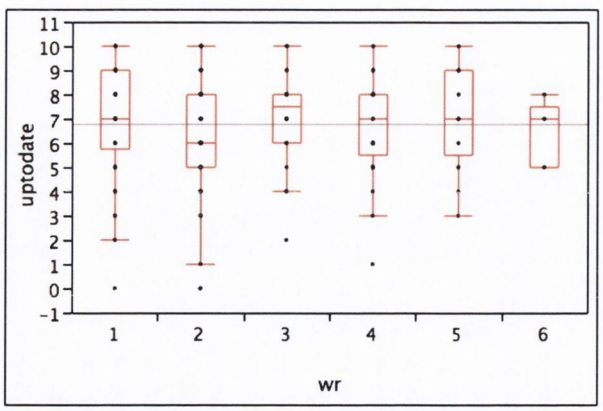


Table 8.6-74 Medians and quantiles of (ability to keep up to date) by working relationship

Level	Minimum	10%	25%	Median	75%	90%	Maximum
1	0	4	5.75	7	9	9	10
2	0	4	5	6	8	9	10
3	2	4	6	7.5	8	9.3	10
4	1	4.8	5.5	7	8	9	10
5	3	4.2	5.5	7	9	9.8	10
6	5	5	5	7	7.5	8	8

Analysis of variance (Kruskal-Wallis) showed no significant differences (p=0.2893)

Table 8.6-75 Contingency analysis of the iv question by working relationship

Count Col % Row %	Wrong	Correct	
1	36 23.53 66.67	18 24.00 33.33	54
2	58 37.91 68.24	27 36.00 31.76	85
3	17 11.11 65.38	9 12.00 34.62	26
4	22 14.38 59.46	15 20.00 40.54	37
5	15 9.80 71.43	6 8.00 28.57	21
6	5 3.27 100.00	0 0.00 0.00	5
	153	75	228

Chi-squared values

Test	Chi-squared	Prob>ChiSq
Likelihood Ratio	5.207	0.3911
Pearson	3.697	**0.5937**

No significant association

Table 8.6-76 Contingency analysis of the acute pain question by working relationship

Count Col % Row %	Wrong	Correct	
1	2 66.67 3.70	52 23.11 96.30	54
2	0 0.00 0.00	85 37.78 100.00	85
3	0 0.00 0.00	26 11.56 100.00	26
4	0 0.00 0.00	37 16.44 100.00	37
5	1 33.33 4.76	20 8.89 95.24	21
6	0 0.00 0.00	5 2.22 100.00	5
	3	225	228

Chi-squared values

Test	Chi-squared	Prob>ChiSq
Likelihood Ratio	6.796	0.2363
Pearson	6.332	**0.2752**

No significant association

Figure 8.6-26 One way analysis of (enjoy undergraduate studies) by place of work

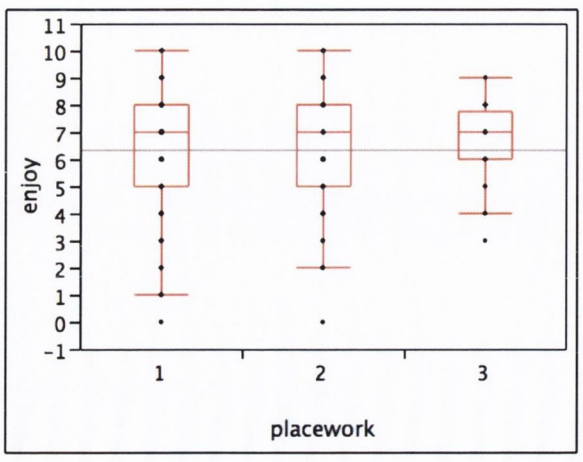


Table 8.6-77 Medians and quantiles of (enjoy undergraduate studies) by place of work

Level	Minimum	10%	25%	Median	75%	90%	Maximum
1	0	3	5	7	8	9	10
2	0	3.7	5	7	8	9	10
3	3	4	6	7	7.75	8	9

Analysis of variance (Kruskal-Wallis) showed no significant differences (χ^2 0.1624; *DF* 2; *p*=0.9220)

Figure 8.6-27 One way analysis of (ability to practice dentistry) by place of work

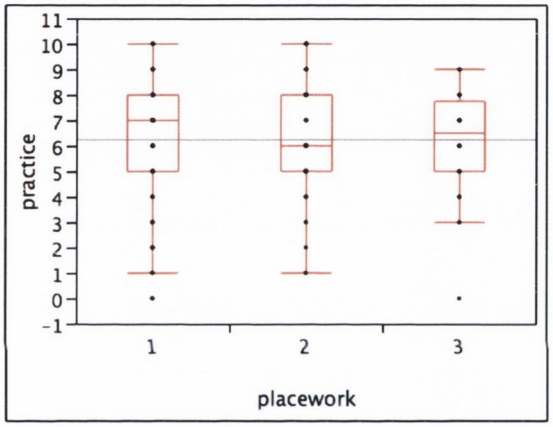


Table 8.6-78 Medians and quantiles of (ability to practice dentistry) by place of work

Level	Minimum	10%	25%	Median	75%	90%	Maximum
1	0	2	5	7	8	9	10
2	1	4	5	6	8	10	10
3	0	3.5	5	6.5	7.75	8.5	9

Analysis of variance (Kruskal-Wallis) showed no significant differences (χ^2 1.1361; *DF* 2; *p*=0.5666)

Figure 8.6-28 One way analysis of (communicate with the patients) by place of work

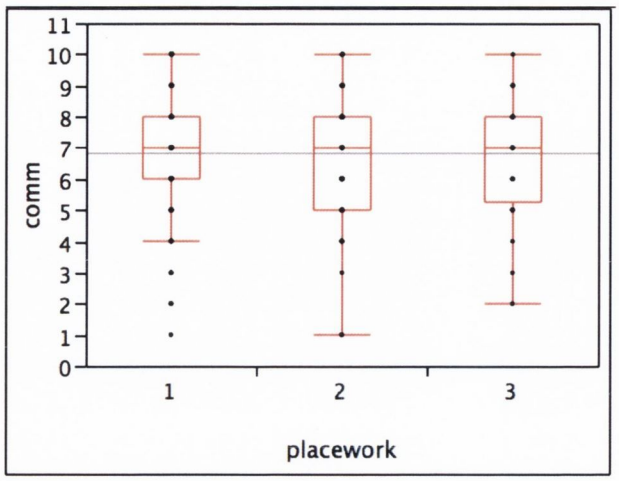


Table 8.6-79 Medians and quantiles of (communicate with the patients) by place of work

Level	Minimum	10%	25%	Median	75%	90%	Maximum
1	1	4	6	7	8	9	10
2	1	4.7	5	7	8	9	10
3	2	3.5	5.25	7	8	9	10

Analysis of variance (Kruskal-Wallis) showed no significant differences (χ^2 0.2727; *DF* 2; *p*=0.8725)

Figure 8.6-29 One way analysis of (ability to keep up to date) by place of work

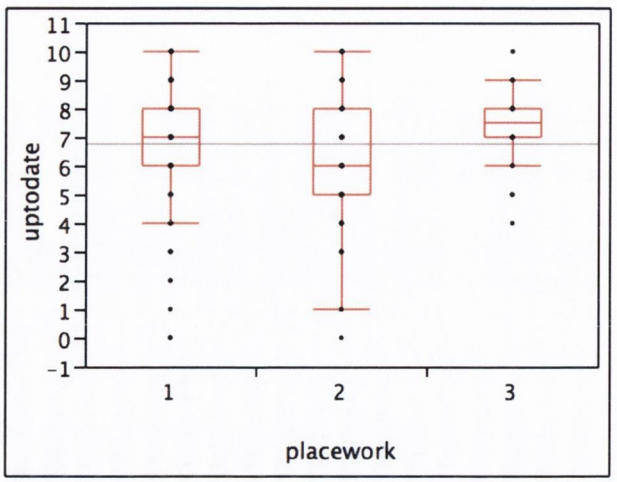


Table 8.6-80 Medians and quantiles of (ability to keep up to date) by place of work

Level	Minimum	10%	25%	Median	75%	90%	Maximum
1	0	4	6	7	8	9	10
2	0	4	5	6	8	9	10
3	4	5	7	7.5	8	9	10

Analysis of variance (Kruskal-Wallis) showed no significant differences (χ^2 4.1745; *DF* 2; *p*=0.1240)

Table 8.6-81 Contingency analysis of the iv question by place of work

Count Col % Row %	Wrong	Correct	
1	81 52.94 68.64	37 49.33 31.36	118
2	59 38.56 68.60	27 36.00 31.40	86
3	13 8.50 54.17	11 14.67 45.83	24
	153	75	228

Chi-squared values

Test	Chi-squared	Prob>ChiSq
Likelihood Ratio	1.944	0.3783
Pearson	2.034	**0.3616**

No significant association

Table 8.6-82 Contingency analysis of the pulpotomy question by place of work

Count Col % Row %	Wrong	Correct	
1	37 46.84 31.36	81 54.36 68.64	118
2	32 40.51 37.21	54 36.24 62.79	86
3	10 12.66 41.67	14 9.40 58.33	24
	79	149	228

Chi-squared values

Test	Chi-squared	Prob>ChiSq
Likelihood Ratio	1.328	0.5147
Pearson	1.336	**0.5127**

No significant association

Table 8.6-83 Contingency analysis of the acute pain question by place of work

Count Col % Row %	Wrong	Correct	
1	1 33.33 0.85	117 52.00 99.15	118
2	2 66.67 2.33	84 37.33 97.67	86
3	0 0.00 0.00	24 10.67 100.00	24
	3	225	228

Chi-squared values

Test	Chi-squared	Prob>ChiSq
Likelihood Ratio	1.414	0.4931
Pearson	1.195	**0.5503**

No significant association

Table 8.6-84 Contingency analysis of the replantation question by place of work

Count Col % Row %	0	1	
1	106 50.96 89.83	12 60.00 10.17	118
2	80 38.46 93.02	6 30.00 6.98	86
3	22 10.58 91.67	2 10.00 8.33	24
	208	20	228

Chi-squared values

Test	Chi-squared	Prob>ChiSq
Likelihood Ratio	0.651	0.7221
Pearson	0.640	**0.7261**

No significant association

Table 8.6-85 Contingency analysis of current position by being a member of an association

Count Col % Row %	1	2	3	4	5	
No	60 35.3 81.1	3 16.7 4.1	8 30.8 10.8	1 20.00 1.4	2 22.2 2.7	74
Yes	110 64.7 71.4	15 83.3 9.7	18 69.2 11.7	4 80.00 2.6	7 77.8 4.5	154
	170	18	26	5	9	228

Chi-squared values

Test	Chi-squared	Prob>ChiSq
Likelihood Ratio	3.799	0.480
Pearson	3.489	**0.434**

No significant association

Table 8.6-86 Contingency analysis of working full or part time by subscription to a journal

Count Col % Row %	Full	Part	
No	102 55.14 77.27	30 69.77 22.73	132
Yes	83 44.86 86.46	13 30.23 13.54	96
	185	43	228

Fisher's exact test

Fisher's Exact Test	Prob
Left	0.0558
Right	0.9741
2-Tail	**0.0885**

No significant association

Table 8.6-87 Contingency analysis of working full or part time by access to journals online

Count Col % Row %	Full	Part	
No	62 33.51 72.94	23 53.49 27.06	85
Yes	123 66.49 86.01	20 46.51 13.99	143
	185	43	228

Fisher's exact test

Fisher's Exact Test	Prob
Left	0.0125
Right	0.9951
2-Tail	**0.0221**

Significant association

Table 8.6-88 Contingency analysis of working full or part time by being a member of an association etc

Count Col % Row %	Full	Part	
No	53 28.6 71.6	21 48.8 28.4	74
Yes	132 71.4 85.7	22 51.2 14.3	154
	185	43	228

Chi-squared values

Test	Chi-squared	Prob>ChiSq
Likelihood Ratio	6.190	0.011
Pearson	6.487	**0.013**

Significant association

Table 8.6-89 Contingency analysis of working full or part time by (how many conferences have you attended in the last two years?)

Count	Full	Part	
0	25 13.51 78.13	7 16.28 21.88	32
1	23 12.43 71.88	9 20.93 28.13	32
2	38 20.54 71.70	15 34.88 28.30	53
3	28 15.14 84.85	5 11.63 15.15	33
4	23 12.43 95.83	1 2.33 4.17	24
5	14 7.57 87.50	2 4.65 12.50	16
5+	34 18.38 89.47	4 9.30 10.53	38
	185	43	228

Chi-squared values

Test	Chi-squared	Prob>ChiSq
Likelihood Ratio	11.973	0.0626
Pearson	10.903	**0.0914**

No significant association

Table 8.6-90 Contingency analysis of working full or part time by how many practicals (Hands on) have you attended in the last two years?

Count Col % Row %	Full	No	
0	54 29.19 75.00	18 41.86 25.00	72
1	53 28.65 88.33	7 16.28 11.67	60
2	38 20.54 79.17	10 23.26 20.83	48
3	15 8.11 71.43	6 13.95 28.57	21
4	12 6.49 92.31	1 2.33 7.69	13
5	3 1.62 100.00	0 0.00 0.00	3
6	10 5.41 90.91	1 2.33 9.09	11
	185	43	228

Chi-squared values

Test	Chi-squared	Prob>ChiSq
Likelihood Ratio	8.576	0.1989
Pearson	7.662	**0.2639**

No significant association

Table 8.6-91 Contingency analysis of working relation by being a member of an association e.t.c.

Count Col % Row %	Pr. Practice Owner	Pr. Practice Assoc.	Hospital	HSE	Comb.	Other	
No	11 20.4 14.9	34 40.00 45.9	9 34.6 12.2	13 35.1 17.6	5 23.8 6.8	2 40.00 2.70	74
Yes	43 79.6 27.9	51 60.00 33.1	17 65.4 11.0	24 64.9 15.6	16 76.2 10.4	3 60.00 1.9	154
	54	85	26	37	21	5	228

Chi-squared values

Test	**Chi-squared**	**Prob>ChiSq**
Likelihood Ratio	7.096	0.214
Pearson	6.827	**0.234**

No significant association

Table 8.6-92 Contingency analysis of place of work by subscription to a journal

Count Col % Row %	City	Town	Rural	
No	67 56.78 50.76	50 58.14 37.88	15 62.50 11.36	132
Yes	51 43.22 53.13	36 41.86 37.50	9 37.50 9.38	96
	118	86	24	228

Chi-squared values

Test	**Chi-squared**	**Prob>ChiSq**
Likelihood Ratio	0.273	0.8722
Pearson	0.271	**0.8732**

No significant association

Table 8.6-93 Contingency analysis of place of work by online access to journal

Count Col % Row %	City	Town	Rural	
No	38 32.20 44.71	37 43.02 43.53	10 41.67 11.76	85
Yes	80 67.80 55.94	49 56.98 34.27	14 58.33 9.79	143
	118	86	24	228

Chi-squared values

Test	Chi-squared	Prob>ChiSq
Likelihood Ratio	2.714	0.2574
Pearson	2.711	**0.2578**

No significant association

Table 8.6-94 Contingency analysis of place of work by being a member of an association

Count Col % Row %	City	Town	Rural	
No	37 31.4 50.00	28 32.6 37.8	9 37.5 12.2	74
Yes	81 67.6 52.6	58 67.4 37.7	15 62.5 9.7	154
	118	86	24	228

Chi-squared values

Test	Chi-squared	Prob>ChiSq
Likelihood Ratio	0.338	0.845
Pearson	0.344	**0.842**

No significant association

Table 8.6-95 Contingency analysis of place of work by (how many conferences have you attended in the last two years?)

Count Col % Row %	City	Town	Rural	
0	12 10.17 37.50	18 20.93 56.25	2 8.33 6.25	32
1	13 11.02 40.63	15 17.44 46.88	4 16.67 12.50	32
2	26 22.03 49.06	21 24.42 39.62	6 25.00 11.32	53
3	17 14.41 51.52	10 11.63 30.30	6 25.00 18.18	33
4	15 12.71 62.50	8 9.30 33.33	1 4.17 4.17	24
5	13 11.02 81.25	3 3.49 18.75	0 0.00 0.00	16
5+	22 18.64 57.89	11 12.79 28.95	5 20.83 13.16	38
	118	86	24	228

Chi-squared values

Test	Chi-squared	Prob>ChiSq
Likelihood Ratio	19.050	0.0873
Pearson	17.579	**0.1291**

No significant association

Table 8.6-96 Contingency analysis of place of work by (how many practicals (Hands on) have you attended in the last two years?)

Count Col % Row %	City	Town	Rural	
0	35 29.66 48.61	31 36.05 43.06	6 25.00 8.33	72
1	34 28.81 56.67	22 25.58 36.67	4 16.67 6.67	60
2	24 20.34 50.00	16 18.60 33.33	8 33.33 16.67	48
3	10 8.47 47.62	7 8.14 33.33	4 16.67 19.05	21
4	5 4.24 38.46	7 8.14 53.85	1 4.17 7.69	13
5	1 0.85 33.33	2 2.33 66.67	0 0.00 0.00	3
5+	9 7.63 81.82	1 1.16 9.09	1 4.17 9.09	11
	118	86	24	228

Chi-squared values

Test	Chi-squared	Prob>ChiSq
Likelihood Ratio	13.262	0.3503
Pearson	12.725	**0.3893**

No significant association

Table 8.6-97 Multivariate correlations between final 4 variables

Nonparametric: Spearman's ρ

Variable	by Variable	Spearman ρ	Prob>|ρ|
practice	enjoy	0.3892	<.0001
comm	enjoy	0.4054	<.0001
comm	practice	0.4225	<.0001
uptodate	enjoy	0.3532	<.0001
uptodate	practice	0.3285	<.0001
uptodate	comm	**0.4463**	<.0001

All pair wise correlations are statistically highly significant, however, the scale of the correlations are modest with the highest between "keep up to date" and "communicate with the patients." at 0.44.

8.7 *Publication details*

European Journal of Dental Education ISSN 1396-5883

The role of the curriculum and other factors in determining the medium- to long-term attitude of the practicing dentist towards life-long learning

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[4] Department of Periodontology, Griffith University, Gold Coast, Qld, Australia

Keywords

Life-long learning; curriculum;
factors; PBL; attitudes; dentistry.

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8.8 Student information leaflet

Dear 2nd year students,

We are carrying out a study to try and determine if evaluation of a dental procedure at the beginning of dental training can be a predictor for future performance at the pre-clinical level and to observe if conventional training significantly improves pre-clinical performance. As you are one of our students, we would be extremely grateful for your help.

In 14 days, each student will be given a consent form by the leading investigator of this study which will be asking you if you want to participate or not in the study. The leading investigator is not directly or indirectly involved in the teaching of undergraduate students. Then, you will all be given an introductory lecture and a demonstration on the design and instrumentation of conventional class I cavity preparation, for an amalgam restoration. Each student will be given a number (code) and a plastic typodont lower left 1st molar and you will be asked to prepare a class I cavity preparation. When you finish with the preparation, you will be asked to place the coded tooth inside a plastic bag and return it to a box marked with a YES if you want to take part in this study or to a box marked with a NO if you do not. Both boxes will be situated in an area close to the clinical laboratory.

Conventional training will take place twice a week for twelve weeks following which the same test will be repeated.

Any information collected will be treated in strict confidence. The study is anonymous and care is taken so that individuals cannot be identified from details in the reports resulting from this study. A decision not to take part in the study will not in any way affect your studies.

If you have any questions regarding the study, please do not hesitate to contact me.

For your kind assistance I thank you in advance

Sincerely yours

Ioannis Polyzois
Lecturer in Periodontology
Dublin Dental School and Hospital
Lincoln Place
Dublin 2

8.9 Consent form

I _____

of _____

_____ consent to participate in the study which will try to determine if evaluation of a dental procedure at the beginning of dental training can be a predictor for future performance at the pre-clinical level and to observe if conventional training significantly improves pre-clinical performance.

I understand that the information I provide will be treated in the strictest confidence, and I also understand that my name will not be mentioned in any reports of the study when the data I provided is published. I have had the opportunity to ask questions and all my questions have been answered to my satisfaction.

I also understand that declining to take part will not in any way affect my studies

Signature:_____

I have explained the nature, purpose, procedures and benefits of this study. I have offered to answer any questions and fully answered such questions. I believe that the participant understands my explanation and has freely given informed consent.

Investigator's name:

Investigator's signature:

Date:

8.10 Publication details

European Journal of Dental Education ISSN 1396-5883

Can evaluation of a dental procedure at the outset of learning predict later performance at the preclinical level? A pilot study

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Keywords

Preclinical, performance;

undergraduate; predictor, manual dexterity.

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8.11 Student questionnaire

Clinical teaching in Restorative Dentistry
Dublin Dental School & Hospital

You are invited to give your opinion on aspects of the clinical teaching in Restorative Dentistry. Your answers should be based on your overall experience of the different supervisors you have in the current academic year.

Please indicate your current year in the course: Year: 3rd ☐ 4th ☐ 5th ☐

In general the current clinical supervisors in Restorative Dentistry:

1. **Establish a good learning environment (approachable, non-threatening, enthusiastic, etc)**

0	1	2	3	4	5
Don't know/ Not Applicable	Never/ Poor	Seldom/ Mediocre	Sometimes/ Good	Often/ Very Good	Always/ Superb

2. **Stimulate me to learn independently**

0	1	2	3	4	5
Don't know/ Not Applicable	Never/ Poor	Seldom/ Mediocre	Sometimes/ Good	Often/ Very Good	Always/ Superb

3. **Allow me autonomy appropriate to my level/experience/competence**

0	1	2	3	4	5
Don't know/ Not Applicable	Never/ Poor	Seldom/ Mediocre	Sometimes/ Good	Often/ Very Good	Always/ Superb

4. **Organize clinic time to allow for both teaching and care giving**

0	1	2	3	4	5
Don't know/ Not Applicable	Never/ Poor	Seldom/ Mediocre	Sometimes/ Good	Often/ Very Good	Always/ Superb

5. **Offer regular feedback (both positive and negative)**

0	1	2	3	4	5
Don't know/ Not Applicable	Never/ Poor	Seldom/ Mediocre	Sometimes/ Good	Often/ Very Good	Always/ Superb

6. Clearly specify what I am expected to know and do during the clinic

0	1	2	3	4	5
Don't know/ Not Applicable	Never/ Poor	Seldom/ Mediocre	Sometimes/ Good	Often/ Very Good	Always/ Superb

7. Adjust teaching to my needs (experience, competence, etc)

0	1	2	3	4	5
Don't know/ Not Applicable	Never/ Poor	Seldom/ Mediocre	Sometimes/ Good	Often/ Very Good	Always/ Superb

8. Ask questions that promote learning (clarification, probing questions, reflective questions, etc)

0	1	2	3	4	5
Don't know/ Not Applicable	Never/ Poor	Seldom/ Mediocre	Sometimes/ Good	Often/ Very Good	Always/ Superb

9. Give clear explanations/reasons for opinions, advice, actions, etc.

0	1	2	3	4	5
Don't know/ Not Applicable	Never/ Poor	Seldom/ Mediocre	Sometimes/ Good	Often/ Very Good	Always/ Superb

10. Adjust teaching to diverse settings (chairside, theatre, x-ray view box, etc.)

0	1	2	3	4	5
Don't know/ Not Applicable	Never/ Poor	Seldom/ Mediocre	Sometimes/ Good	Often/ Very Good	Always/ Superb

11. Coach me on my clinical /technical skills (diagnostic, examination, procedural , lab, etc.)

0	1	2	3	4	5
Don't know/ Not Applicable	Never/ Poor	Seldom/ Mediocre	Sometimes/ Good	Often/ Very Good	Always/ Superb

12. Incorporate research data and/or practice guidelines into teaching.

0	1	2	3	4	5
Don't know/ Not Applicable	Never/ Poor	Seldom/ Mediocre	Sometimes/ Good	Often/ Very Good	Always/ Superb

13. Teach diagnostic skills (clinical reasoning, selection/interpretation of tests, etc)

0	1	2	3	4	5
Don't know/ Not Applicable	Never/ Poor	Seldom/ Mediocre	Sometimes/ Good	Often/ Very Good	Always/ Superb

14. Teach effective patient communication skills

0	1	2	3	4	5
Don't know/ Not Applicable	Never/ Poor	Seldom/ Mediocre	Sometimes/ Good	Often/ Very Good	Always/ Superb

15. Teach principles of cost-appropriate care (resource utilization, etc)

0	1	2	3	4	5
Don't know/ Not Applicable	Never/ Poor	Seldom/ Mediocre	Sometimes/ Good	Often/ Very Good	Always/ Superb

16. List (from 1-5) in order of importance (1 being the most important) the attributes that you consider to be most important in clinical teaching.

Enthusiasm/ approachability ☐

Receiving positive and negative feedback in a way that helps learning ☐

Coaching on clinical/technical skills which are evidence based ☐

Stimulating independent learning by asking questions ☐

Making clear what should be known and done during clinics ☐

Describe any other attributes you consider important:

_____

_____

_____

_____

17. List (from 1-5) in order of importance (1 being the most important) the aspects of the clinical teaching that you consider to be least helpful to learning

Lack of enthusiasm/interest in teaching ☐

Receiving a lot of negative feedback ☐

Rarely receiving positive feedback ☐

Rarely receiving help if I am out of my depth ☐

Disagreement about treatment plan amongst teachers ☐

Describe any other attributes you consider unhelpful:

_____

_____

_____

_____

8.12 Supervisor questionnaire

Clinical teaching in Restorative Dentistry
Dublin Dental School & Hospital

You are invited to give your opinion on aspects of the clinical teaching in Restorative Dentistry. Your answers should be based on your overall experience of the different students you have in the current academic year.

I am supervising students that are currently in the: 3rd ☐ 4th ☐ 5th ☐ year.

In general, as a clinical supervisor in Restorative Dentistry, I feel that I:

1. **Establish a good learning environment (approachable, non-threatening, enthusiastic, etc)**

0	1	2	3	4	5
Don't know/ Not Applicable	Never/ Poor	Seldom/ Mediocre	Sometimes/ Good	Often/ Very Good	Always/ Superb

2. **Stimulate students to learn independently**

0	1	2	3	4	5
Don't know/ Not Applicable	Never/ Poor	Seldom/ Mediocre	Sometimes/ Good	Often/ Very Good	Always/ Superb

3. **Allow students autonomy appropriate to their level/experience/competence**

0	1	2	3	4	5
Don't know/ Not Applicable	Never/ Poor	Seldom/ Mediocre	Sometimes/ Good	Often/ Very Good	Always/ Superb

4. **Organize clinic time to allow for both teaching and care giving**

0	1	2	3	4	5
Don't know/ Not Applicable	Never/ Poor	Seldom/ Mediocre	Sometimes/ Good	Often/ Very Good	Always/ Superb

5. **Offer regular feedback (both positive and negative)**

0	1	2	3	4	5
Don't know/ Not Applicable	Never/ Poor	Seldom/ Mediocre	Sometimes/ Good	Often/ Very Good	Always/ Superb

6. **Clearly specify what students are expected to know and do during the clinic**

0	1	2	3	4	5
Don't know/	Never/	Seldom/	Sometimes/	Often/	Always/

Not Applicable	Poor	Mediocre	Good	Very Good	Superb

7. Adjust teaching to their needs (experience, competence, etc)

0	1	2	3	4	5
Don't know/ Not Applicable	Never/ Poor	Seldom/ Mediocre	Sometimes/ Good	Often/ Very Good	Always/ Superb

8. Ask questions that promote learning (clarification, probing questions, reflective questions, etc)

0	1	2	3	4	5
Don't know/ Not Applicable	Never/ Poor	Seldom/ Mediocre	Sometimes/ Good	Often/ Very Good	Always/ Superb

9. Give clear explanations/reasons for opinions, advice, actions, etc.

0	1	2	3	4	5
Don't know/ Not Applicable	Never/ Poor	Seldom/ Mediocre	Sometimes/ Good	Often/ Very Good	Always/ Superb

10. Adjust teaching to diverse settings (chairside, theatre, x-ray view box, etc.)

0	1	2	3	4	5
Don't know/ Not Applicable	Never/ Poor	Seldom/ Mediocre	Sometimes/ Good	Often/ Very Good	Always/ Superb

11. Coach them on their clinical /technical skills (diagnostic, examination, procedural , lab, etc.)

0	1	2	3	4	5
Don't know/ Not Applicable	Never/ Poor	Seldom/ Mediocre	Sometimes/ Good	Often/ Very Good	Always/ Superb

12. Incorporate research data and/or practice guidelines into teaching.

0	1	2	3	4	5
Don't know/ Not Applicable	Never/ Poor	Seldom/ Mediocre	Sometimes/ Good	Often/ Very Good	Always/ Superb

13. Teach diagnostic skills (clinical reasoning, selection/interpretation of tests, etc)

0	1	2	3	4	5
Don't know/ Not Applicable	Never/ Poor	Seldom/ Mediocre	Sometimes/ Good	Often/ Very Good	Always/ Superb

14. Teach effective patient communication skills

0	1	2	3	4	5
Don't know/ Not Applicable	Never/ Poor	Seldom/ Mediocre	Sometimes/ Good	Often/ Very Good	Always/ Superb

15. Teach principles of cost-appropriate care (resource utilization, etc)

0	1	2	3	4	5
Don't know/ Not Applicable	Never/ Poor	Seldom/ Mediocre	Sometimes/ Good	Often/ Very Good	Always/ Superb

16. List (from 1-5) in order of importance (1 being the most important) the attributes that you consider to be most important for in clinical teaching.

Enthusiasm/ approachability ☐

Giving positive and negative feedback in a way that helps learning ☐

Coaching on clinical/technical skills which are evidence based ☐

Stimulating independent learning by asking questions ☐

Making clear what should be known and done during clinics ☐

Describe any other attributes you consider important:

_____

_____

_____

_____

17. List (from 1-5) in order of importance (1 being the most important) the aspects of the clinical teaching that you consider to be least helpful to learning

Lack of enthusiasm/interest in teaching ☐

Giving a lot of negative feedback ☐

Rarely giving positive feedback ☐

Rarely giving help if a student is out of his/her depth ☐

Disagreement about treatment plan amongst teachers ☐

Describe any other attributes you consider unhelpful:

8.13 Information leaflet

Dear Colleague,

We recently carried out a study investigating if there was an agreement between the students and supervisors on the quality of clinical teaching in Restorative Dentistry in the Dublin Dental School and Hospital. In addition, we also tried to identify differences on how effective clinical teaching is perceived between three academic years and the existence of any similarities between students and supervisors perceptions of specific teaching behaviours that are most and least helpful in learning. As you are one of the restorative supervisors, we would be extremely grateful for your feedback regarding the results of this study.

Your contribution could greatly help us improve the education offered in the Dublin Dental School and Hospital and therefore we hope that as one of our staff members you will consider devoting a few minutes of your time to fill in this questionnaire.

In the envelop provided you will find:
A) An outline of the main points of this study attached to **the questionnaire that we would like you to complete.**
B) A copy of the study, in case you are interested to read more about the way this was conducted and about the results before answering the questions. (DO NOT complete the questionnaire attached)
C) An addressed and pre-stamped envelop.
Please respond to the simple questions in the pages that follow and return it to us at your earliest convenience. (Alternatively, you could drop it off in department 2).

Any information collected will be treated in strict confidence. The questionnaire is anonymous and care is taken so that individuals cannot be identified from details in the reports resulting from this study.

For your kind assistance I thank you in advance

Sincerely yours

Ioannis Polyzois
Lecturer in Periodontology
Dublin Dental School and Hospital
Lincoln Place
Dublin 2

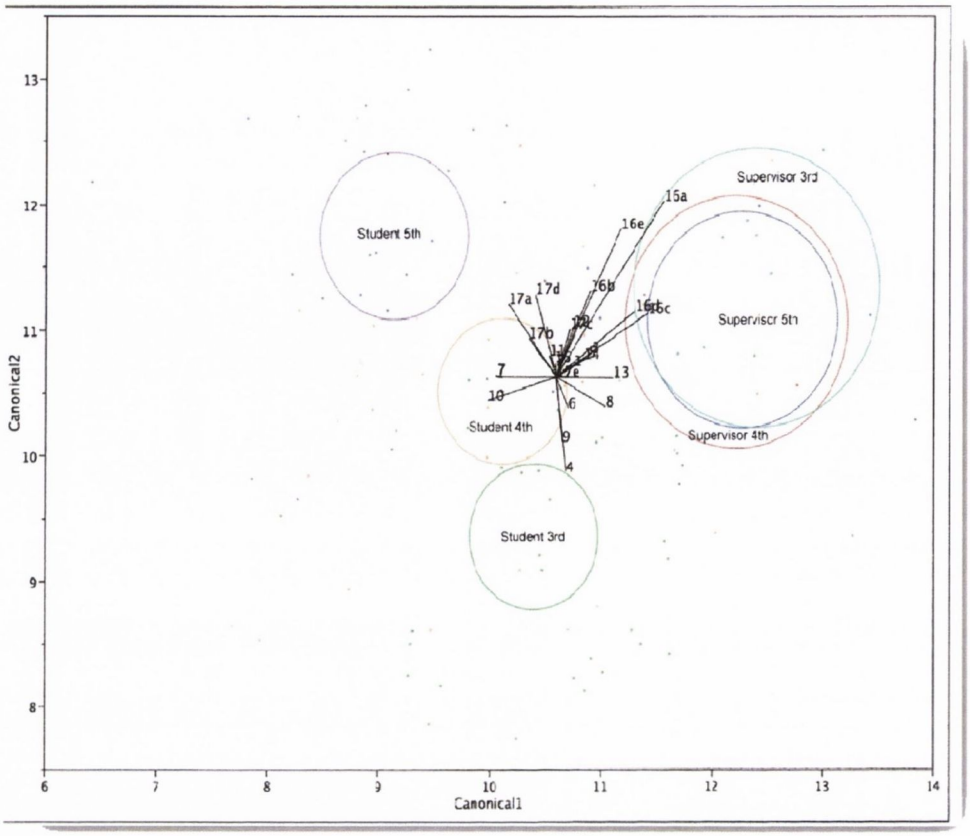
8.14 Outline of the study and questionnaire

Clinical teaching in restorative dentistry and the variation between students' and supervisors' perceptions of its effectiveness

Supervisors' Feedback

Objectives: To investigate if there was an agreement between the students and supervisors on the quality of clinical teaching in Restorative Dentistry in the Dublin Dental School and Hospital and to identify differences on how effective clinical teaching is perceived across three academic years. In addition it aimed to identify the existence of any similarities between students' and supervisors' perceptions of specific teaching behaviours that are most and least helpful in learning.

Materials and Methods: An anonymous questionnaire based on the above objectives was distributed to three cohorts of undergraduate students and 3 cohorts of clinical supervisors. The response rate was 94% for the 1st, 94% for the second and 63% for the third student cohort. Twenty one (21) out of the 36 supervisors returned the questionnaire. Analysis of the clinical questionnaire was carried out in order to find the distributions of the variables between the groups. These distributions were compared using a non-parametric analysis (Kruskal–Wallis). The degree of association was measured by the Pearson's χ^2 values.



- In the graph above (canonical plot), the lines correspond to the questions.
- The length of each line reflects how variable the responses to that question were. Long lines means more variability and vice versa.
- Each category mean is a labelled circle giving an overall of 6 circles (the circle labelled "Supervisor 3rd" corresponds to supervisors in year 3 and so on).
- Groups that are significantly different tend to have non-intersecting circles.
- The 3 "Supervisor" categories all overlap indicating that they do not differ significantly in their responses to the questions over the 3 years.
- The 3 "Student" circles do not overlap with each other or with the "supervisor" circles. This indicates their answers differ across the 3 years and they also differ with respect to the supervisors.

Student Results:

- Students from all 3 groups scored the enthusiasm and approachability of their clinical supervisors above average.
- Students reported that supervisors allowed them the appropriate autonomy and that after clinical sessions they usually felt stimulated and had a desire to learn more on their own.
- They also evaluated the way supervisors explain different procedures, the feedback that they receive from them and the way they adjust teaching to different settings as slightly above average.
- Students from all three years reported that they were neither very satisfied nor very dissatisfied from their clinical teaching with a few statistically significant differences across the 3 years of students.
- The clinical teaching was evaluated as slightly below average regarding organisation of clinical time and teaching of diagnostic, clinical, technical and communication skills.
- Additionally, students did not feel that they were taught efficiently about the principles of cost-appropriate care and they did not think that their clinical supervisors made enough effort to incorporate research data or guidelines into teaching.
- There were some highly significant associations between year and level of response regarding the questions that clinical supervisors are asking in order to promote learning. 5^{th} year students were clearly unimpressed while 4^{th} and 3^{rd} year students were relatively satisfied. The 3^{rd} year students were more satisfied than the other two cohorts by the ability of clinical supervisors to organise clinics in such a way that time was well spent for either teaching or treating.
- All cohorts listed enthusiasm as the most important attribute in clinical teaching.
- Making clear what should be known and expected during clinics were considered very important for the 3^{rd} and 4^{th} year students but not for the students in the 5^{th} year who, considered evidence-based teaching as more important.
- When asked to list in order of importance the aspects of clinical teaching that they consider least helpful to learning, students from the 3^{rd} and 4^{th} year listed not receiving help when out of their depth as their number one choice. The 5^{th} year students however considered disagreement about treatment plans amongst different teachers as the least helpful variable. As expected, all cohorts of students agreed that lack of enthusiasm is very unhelpful.
- When students were asked for further comments they noted that they found the lack of communication between the supervisors when treatment plans are made particularly unhelpful. Furthermore, many supervisors were asked to cover certain clinics without being fully

aware of the level of knowledge and experience of the students they are supervising.

- Finally, students felt that very often there was not enough faculty coverage on the floor.

Supervisors' Results:

- The supervisors gave a high degree of straight line responses (awarding a similar score in the majority of questions) and generally felt very good about the level of clinical teaching.
- Supervisors replied with a great deal of similarity across the 3 years. They rated enthusiasm and approachability as the least important attribute for a supervisor in clinical teaching and they selected "giving positive and negative feedback in a way that helps learning" as the most important one.
- When asked to list in order of importance the aspects of clinical teaching that they consider to be least helpful to learning, "rarely giving help if a student is out of his/her depth" was their first choice and "rarely giving positive feed-back" was their last.
- Supervisors seemed to agree with the students in that they are not very efficient in teaching them the principles of cost-appropriate care.
- What is very interesting is the high degree of variability concerning what the supervisors thought was important but also the high degree of similarity in what they considered unhelpful. It was exactly the opposite for the students.

Which of the findings above, if any, surprised you the most and why?

_____

_____

_____

_____

_____

_____

_____

Would you think of incorporating any of these findings in your supervisory practice?

In which way, if any, do these findings fit with your own observations of the student needs over the years?

The graph above illustrates that students and supervisors differed greatly in their overall responses. Does this surprise you? How would you explain this finding?

In which ways, if any, do you receive feedback from the students about their experiences and needs?

What structures for feedback regarding the students' experiences of your teaching (formal / informal) are currently available?

Do you think that these structures are sufficient /insufficient?

Do you value students' feedback? Do you think that you have enough time to discuss individual progress with the students?

Students reported a lack of clarity regarding treatment plans. Do you agree with this? If yes, which factors do you think are contributing to this finding?

Do you agree with the supervisor's responses? Please explain the reasons for your answer.

_____

_____

_____

_____

_____

What do you think is the role of the supervisor?

_____

_____

_____

_____

_____

Which aspects of this role do you rate as the most significant?

_____

_____

_____

_____

_____

Do you think that there is a need for future research in relation to student learning needs and supervisor/teaching practice? If so, do you have any suggestions?

Student Learning:

_____

_____

Supervisor/ teaching practice:

_____

_____

8.15 Scores from the discriminant analysis

Table 8.15-1 Discriminant Scores

Row	Actual	SqDist(Actual)	Prob(Actual)	-Log(Prob)		Predicted	Prob(Pred)	Others
1	1stu	36.0004	0.9927	0.007		1stu	0.9927	
2	1stu	33.1967	0.7323	0.312		1stu	0.7323	3stu 0.10
3	1stu	33.1691	0.7174	0.332		1stu	0.7174	2stu 0.11
4	1stu	15.9802	0.7255	0.321		1stu	0.7255	2stu 0.23
5	1stu	23.4925	0.4064	0.901		1stu	0.4064	2stu 0.14 3sup 0.28
6	1stu	22.4213	0.2235	1.499	*	1sup	0.3362	2sup 0.20 3sup 0.18
7	1stu	23.2729	0.9134	0.091		1stu	0.9134	
8	1stu	116.363	0.9920	0.008		1stu	0.9920	
9	1stu	18.7131	0.4929	0.707		1stu	0.4929	2stu 0.40
10	1stu	30.0823	0.3027	1.195	*	3stu	0.3390	2stu 0.29
11	1stu	28.3096	0.2497	1.388	*	2stu	0.5940	3stu 0.10
12	1stu	21.2184	0.9269	0.076		1stu	0.9269	
13	1stu	16.4810	0.7155	0.335		1stu	0.7155	2stu 0.11
14	1stu	23.7084	0.5883	0.531		1stu	0.5883	2stu 0.31
15	1stu	17.0173	0.5426	0.611		1stu	0.5426	2sup 0.23 2stu 0.11
16	1stu	26.0219	0.7928	0.232		1stu	0.7928	2stu 0.15
17	1stu	25.0895	0.0327	3.419	*	3stu	0.8848	
18	1stu	15.0081	0.8171	0.202		1stu	0.8171	
19	1stu	29.2445	0.9130	0.091		1stu	0.9130	
20	1stu	22.9216	0.1086	2.221	*	1sup	0.5266	2stu 0.31
21	1stu	31.8195	0.5248	0.645		1sup	0.5248	2stu 0.47
22	1stu	46.0193	0.8325	0.183		1stu	0.8325	2stu 0.15
23	1stu	26.7539	0.7570	0.278		1stu	0.7570	
24	1stu	27.9616	0.7617	0.272		1stu	0.7617	2stu 0.20
25	1stu	56.6891	0.1727	1.756	*	2stu	0.7181	3stu 0.11
26	1stu	19.4130	0.4698	0.756		1stu	0.4698	1sup 0.10 2stu 0.16 3stu 0.11
27	1stu	27.7887	0.9016	0.104		1stu	0.9016	
28	1stu	15.3832	0.9526	0.049		1stu	0.9526	
29	1stu	42.7768	0.0168	4.084	*	1sup	0.3853	2sup 0.24 3sup 0.32
30	1stu	40.5662	0.0274	3.597	*	3stu	0.9491	
31	1stu	20.4784	0.3234	1.129	*	2stu	0.3364	3stu 0.32
32	1stu	29.8748	0.3351	1.093	*	2sup	0.3759	3sup 0.17
33	1stu	24.1798	0.5845	0.537		1stu	0.5845	2stu 0.23
34	2stu	26.8684	0.0699	2.661	*	1sup	0.2711	1stu 0.26 2sup 0.23 3sup 0.16
35	2stu	19.2070	0.4099	0.892	*	1stu	0.5465	
36	2stu	21.6751	0.3131	1.161	*	3stu	0.6614	
37	2stu	27.2914	0.3750	0.981	*	1stu	0.5801	
38	2stu	28.9611	0.0806	2.518	*	3stu	0.5778	1stu 0.12 2sup

Row	Actual	SqDist(Actual)	Prob(Actual)	-Log(Prob)		Predicted	Prob(Pred)	Others
								0.16
39	2stu	27.7545	0.2088	1.566	*	3stu	0.6365	1stu 0.15
40	2stu	21.9857	0.1103	2.205	*	2sup	0.3082	1sup 0.26 1stu 0.25
41	2stu	21.1120	0.5277	0.639		2stu	0.5277	3stu 0.47
42	2stu	19.0165	0.9498	0.051		2stu	0.9498	
43	2stu	27.9263	0.8365	0.179		2stu	0.8365	3stu 0.10
44	2stu	14.3054	0.6785	0.388		2stu	0.6785	3stu 0.26
45	2stu	14.6310	0.3472	1.058	*	1stu	0.6405	
46	2stu	20.8763	0.0504	2.988	*	1stu	0.9075	
47	2stu	26.0583	0.0704	2.653	*	1stu	0.8585	
48	2stu	13.7143	0.8722	0.137		2stu	0.8722	
49	2stu	20.4064	0.4391	0.823		2stu	0.4391	1stu 0.28 3stu 0.28
50	2stu	19.4884	0.1418	1.954	*	2sup	0.3552	3sup 0.33
51	2stu	20.4777	0.1939	1.640	*	3stu	0.5251	1stu 0.25
52	2stu	29.2607	0.5339	0.628		2stu	0.5339	3stu 0.41
53	2stu	16.8494	0.7239	0.323		2stu	0.7239	2sup 0.16
54	2stu	24.4719	0.3843	0.956	*	2sup	0.4217	
55	2stu	22.6035	0.8226	0.195		2stu	0.8226	1sup 0.13
56	2stu	33.6110	0.7127	0.339		2stu	0.7127	3stu 0.17
57	2stu	26.1897	0.1838	1.694	*	3sup	0.4062	1sup 0.20 2sup 0.20
58	2stu	26.0614	0.7820	0.246		2stu	0.7820	1stu 0.11
59	2stu	30.8441	0.0110	4.512	*	1sup	0.6872	3sup 0.22
60	2stu	19.8707	0.7302	0.314		2stu	0.7302	
61	2stu	22.0350	0.4990	0.695		2stu	0.4990	1stu 0.45
62	2stu	36.1975	0.5160	0.662		2stu	0.5160	3sup 0.10 3stu 0.17
63	2stu	30.6936	0.7019	0.354		2stu	0.7019	3stu 0.12
64	2stu	13.3470	0.4594	0.778		2stu	0.4594	1stu 0.41
65	2stu	22.5673	0.5588	0.582		2stu	0.5588	1sup 0.17 2sup 0.10
66	2stu	28.5632	0.3277	1.116	*	3stu	0.4584	1stu 0.21
67	3stu	18.0929	0.3224	1.132	*	1stu	0.4789	2stu 0.19
68	3stu	32.5736	0.1678	1.785	*	1sup	0.5060	3sup 0.25
69	3stu	22.3061	0.9353	0.067		3stu	0.9353	
70	3stu	24.4252	0.7170	0.333		3stu	0.7170	
71	3stu	17.2420	0.9781	0.022		3stu	0.9781	
72	3stu	16.6589	0.8549	0.157		3stu	0.8549	
73	3stu	13.7444	0.8573	0.154		3stu	0.8573	2stu 0.11
74	3stu	28.6682	0.9192	0.084		3stu	0.9192	
75	3stu	19.6599	0.1808	1.710	*	2stu	0.4026	1sup 0.18 3sup 0.13
76	3stu	21.9657	0.1005	2.297	*	2sup	0.3620	1stu 0.30 2stu 0.18
77	3stu	24.6946	0.7198	0.329		3stu	0.7198	2stu 0.20
78	3stu	22.6423	0.9908	0.009		3stu	0.9908	
79	3stu	26.6106	0.9051	0.100		3stu	0.9051	
80	3stu	23.3570	0.9512	0.050		3stu	0.9512	

Row	Actual	SqDist(Actual)	Prob(Actual)	-Log(Prob)		Predicted	Prob(Pred)	Others
81	3stu	23.3032	0.8383	0.176		3stu	0.8383	2stu 0.15
82	3stu	29.2440	0.1908	1.657	*	2stu	0.7001	1stu 0.11
83	3stu	24.7875	0.3263	1.120	*	1stu	0.4271	2stu 0.24
84	3stu	16.6505	0.4157	0.878	*	1stu	0.4340	
85	3stu	37.9952	0.9872	0.013		3stu	0.9872	
86	3stu	11.6641	0.9606	0.040		3stu	0.9606	
87	3stu	15.5360	0.5598	0.580		3stu	0.5598	2stu 0.40
88	3stu	26.2318	0.7972	0.227		3stu	0.7972	2stu 0.13
89	3stu	23.2235	0.9977	0.002		3stu	0.9977	
90	3stu	27.0546	0.8088	0.212		3stu	0.8088	2stu 0.12
91	3stu	19.7929	0.7283	0.317		3stu	0.7283	2stu 0.11
92	1sup	14.6769	0.1533	1.875	*	2sup	0.4110	3sup 0.31
93	1sup	12.5942	0.5037	0.686		1sup	0.5037	2sup 0.14 3sup 0.33
94	1sup	16.7176	0.3150	1.155	*	3sup	0.4088	2sup 0.15
95	1sup	12.1883	0.2738	1.295	*	2sup	0.3582	3sup 0.34
96	1sup	17.8790	0.2815	1.268	*	3sup	0.3894	2sup 0.27
97	1sup	9.0515	0.1167	2.148	*	3sup	0.6884	2sup 0.18
98	1sup	9.0515	0.1167	2.148	*	3sup	0.6884	2sup 0.18
99	1sup	14.4406	0.7438	0.296		1sup	0.7438	2stu 0.11
100	1sup	13.0972	0.7650	0.268		1sup	0.7650	
101	1sup	19.3753	0.9592	0.042		1sup	0.9592	
102	1sup	19.3753	0.9592	0.042		1sup	0.9592	
103	2sup	8.1320	0.1848	1.689	*	3sup	0.6884	1sup 0.12
104	2sup	8.1320	0.1848	1.689	*	3sup	0.6884	1sup 0.12
105	2sup	17.9308	0.2743	1.294	*	3sup	0.3894	1sup 0.28
106	2sup	11.6505	0.3582	1.027		2sup	0.3582	1sup 0.27 3sup 0.34
107	2sup	18.2637	0.1454	1.928	*	3sup	0.4088	1sup 0.31
108	2sup	15.1549	0.1400	1.966	*	1sup	0.5037	3sup 0.33
109	2sup	12.7050	0.4110	0.889		2sup	0.4110	1sup 0.15 3sup 0.31
110	2sup	32.2768	0.9519	0.049		2sup	0.9519	
111	2sup	20.2062	0.4035	0.907		2sup	0.4035	2stu 0.34
112	2sup	24.1034	0.2527	1.376	*	2stu	0.3969	1sup 0.15
113	2sup	18.5912	0.5614	0.577		2sup	0.5614	1sup 0.13 3sup 0.31
114	2sup	14.3762	0.4579	0.781		2sup	0.4579	1stu 0.29
115	2sup	19.1218	0.2617	1.341	*	3sup	0.5710	1sup 0.17
116	2sup	39.3956	0.9718	0.029		2sup	0.9718	
117	2sup	18.2435	0.6159	0.485		2sup	0.6159	2stu 0.11 3stu 0.13
118	3sup	17.5611	0.5710	0.560		3sup	0.5710	1sup 0.17 2sup 0.26
119	3sup	12.4265	0.5774	0.549		3sup	0.5774	1sup 0.16 2sup 0.25
120	3sup	13.2478	0.3133	1.161	*	2sup	0.4110	1sup 0.15
121	3sup	13.4140	0.3343	1.096	*	1sup	0.5037	2sup 0.14
122	3sup	16.1964	0.4088	0.895		3sup	0.4088	1sup 0.31 2sup 0.15

Row	Actual	SqDist(Actual)	Prob(Actual)	-Log(Prob)		Predicted	Prob(Pred)	Others
123	3sup	11.7268	0.3448	1.065	*	2sup	0.3582	1sup 0.27
124	3sup	17.2302	0.3894	0.943		3sup	0.3894	1sup 0.28 2sup 0.27
125	3sup	5.5016	0.6884	0.373		3sup	0.6884	1sup 0.12 2sup 0.18
126	3sup	5.5016	0.6884	0.373		3sup	0.6884	1sup 0.12 2sup 0.18

Table 8.15-2 Counts

Counts: Actual Rows by Predicted Columns	1sup	1stu	2sup	2stu	3sup	3stu
1sup	5	0	2	0	4	0
1stu	3	23	1	3	0	3
2sup	1	0	8	1	5	0
2stu	2	5	3	17	1	5
3sup	1	0	2	0	6	0
3stu	1	3	1	2	0	18

Table 8.15-3 Groups

category	Count
1sup	11
1stu	33
2sup	15
2stu	33
3sup	9
3stu	25

8.16 Statistical analysis of the rest of the data collected from the student questionnaire

Table 8.16-1 Contingency analysis of question 1 by academic year

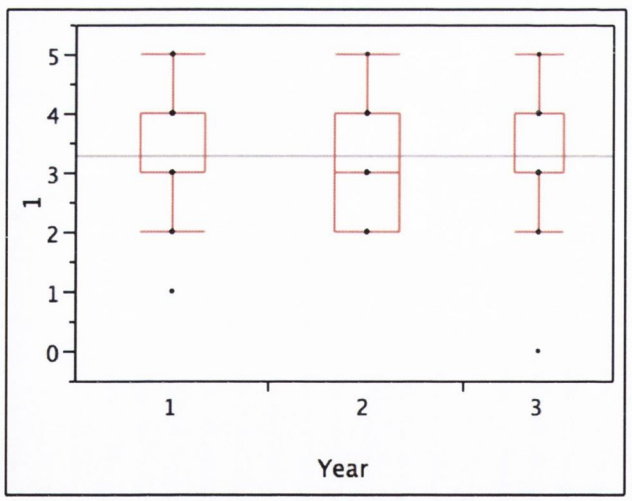
Count Col %	0	1	2	3	4	5	
3rd	0 0.00	1 100.00	4 25.00	9 27.27	15 44.12	4 66.67	33
4th	0 0.00	0 0.00	9 56.25	13 39.39	10 29.41	1 16.67	33
5th	1 100.00	0 0.00	3 18.75	11 33.33	9 26.47	1 16.67	25
	1	1	16	33	34	6	91

Chi-squared values

Test	**Chi-squared**	**Prob>ChiSq**
Pearson	11.851	**0.2952**

No significant association

Figure 8.16-1 One way analysis of question 1 by academic year (1 = 3rd, 2 = 4th, 3 = 5th)



Analysis of variance (Kruskal-Wallis) showed no significant differences (p=0.1166)

Table 8.16-2 Contingency analysis of question 2 by academic year

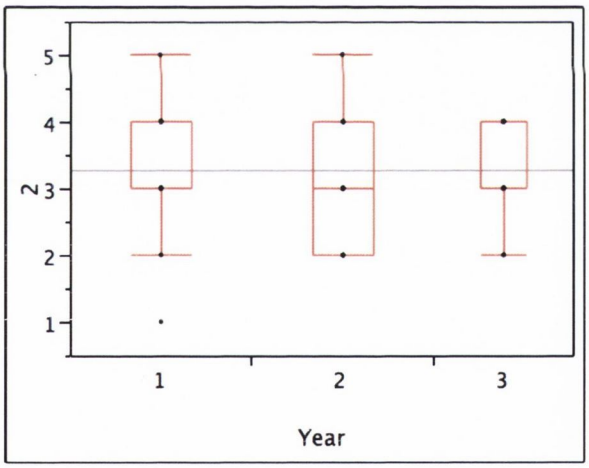
Count Col %	1	2	3	4	5	
3rd	1 100.00	2 14.29	15 36.59	13 43.33	2 40.00	33
4th	0 0.00	9 64.29	14 34.15	7 23.33	3 60.00	33
5th	0 0.00	3 21.43	12 29.27	10 33.33	0 0.00	25
	1	14	41	30	5	91

Chi-squared values

Test	**Chi-squared**	**Prob>ChiSq**
Pearson	11.281	**0.1863**

No significant association

Figure 8.16-2 One way analysis of question 2 by academic year (1 = 3rd, 2 = 4th, 3 = 5th)



Analysis of variance (Kruskal-Wallis) showed no significant differences (p=0.2773)

Table 8.16-3 Contingency analysis of question 3 by academic year

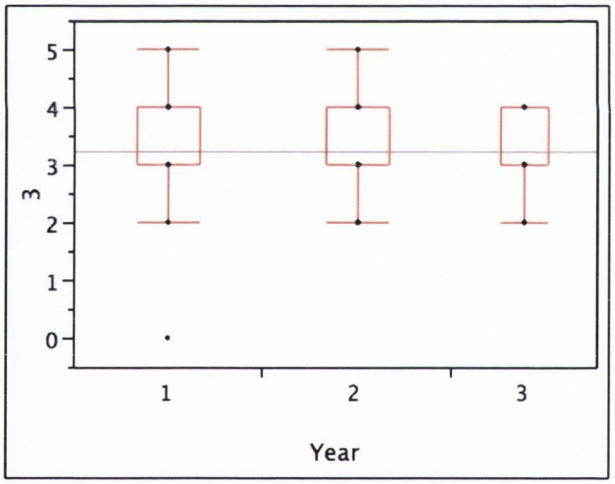
Count Col %	0	2	3	4	5	
3rd	2 100.00	2 16.67	12 27.27	14 50.00	3 60.00	33
4th	0 0.00	7 58.33	17 38.64	7 25.00	2 40.00	33
5th	0 0.00	3 25.00	15 34.09	7 25.00	0 0.00	25
	2	12	44	28	5	91

Chi-squared values

Test	**Chi-squared**	**Prob>ChiSq**
Pearson	12.844	**0.1173**

No significant association

Figure 8.16-3 One way analysis of question 3 by academic year (1 = 3rd, 2 = 4th, 3 = 5th)



Analysis of variance (Kruskal-Wallis) showed no significant differences (p=0.1349)

Table 8.16-4 Contingency analysis of question 5 by academic year

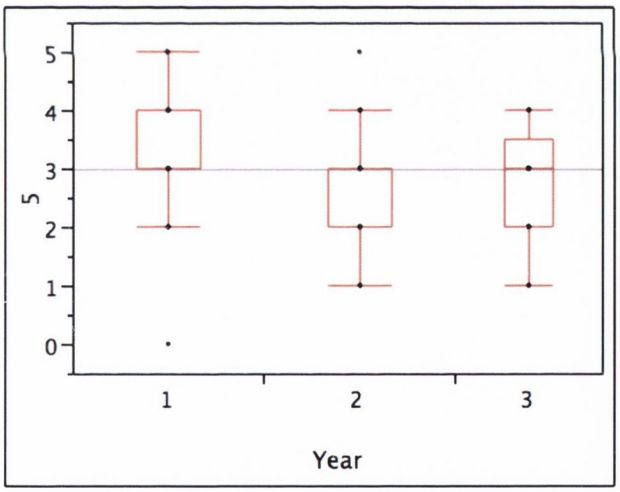
Count Col %	0	1	2	3	4	5	
3rd	1 100.00	0 0.00	6 28.57	10 27.78	13 54.17	3 75.00	33
4th	0 0.00	3 60.00	8 38.10	16 44.44	5 20.83	1 25.00	33
5th	0 0.00	2 40.00	7 33.33	10 27.78	6 25.00	0 0.00	25
	1	5	21	36	24	4	91

Chi-squared values

Test	**Chi-squared**	**Prob>ChiSq**
Pearson	13.283	**0.2083**

No significant association

Figure 8.16-4 One way analysis of question 5 by academic year (1 = 3rd, 2 = 4th, 3 = 5th)



Analysis of variance (Kruskal-Wallis) showed significant differences (p=0.0423)

Table 8.16-5 Contingency analysis of question 6 by academic year

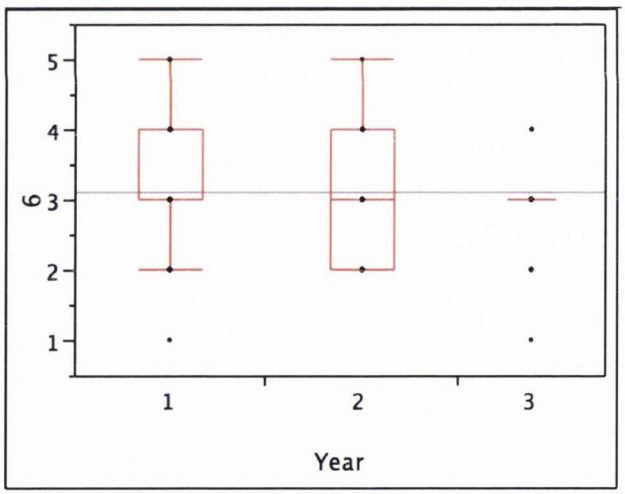
Count Col %	1	2	3	4	5	
3rd	1 50.00	6 31.58	11 26.19	12 50.00	3 75.00	33
4th	0 0.00	9 47.37	14 33.33	9 37.50	1 25.00	33
5th	1 50.00	4 21.05	17 40.48	3 12.50	0 0.00	25
	2	19	42	24	4	91

Chi-squared values

Test	**Chi-squared**	**Prob>ChiSq**
Pearson	12.216	**0.1418**

No significant association

Figure 8.16-5 One way analysis of question 6 by academic year (1 = 3rd, 2 = 4th, 3 = 5th)



Analysis of variance (Kruskal-Wallis) showed no significant differences (p=0.1696)

Table 8.16-6 Contingency analysis of question 7 by academic year

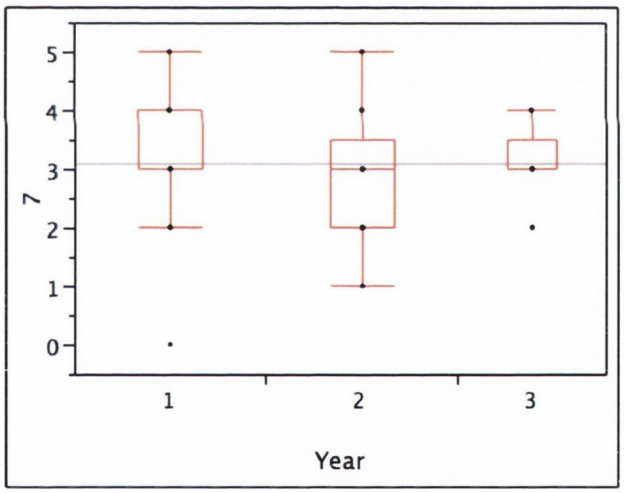
Count Col %	1	2	3	4	5	
3rd	1 50.00	6 31.58	11 26.19	12 50.00	3 75.00	33
4th	0 0.00	9 47.37	14 33.33	9 37.50	1 25.00	33
5th	1 50.00	4 21.05	17 40.48	3 12.50	0 0.00	25
	2	19	42	24	4	91

Chi-squared values

Test	**Chi-squared**	**Prob>ChiSq**
Pearson	8.535	**0.5767**

No significant association

Figure 8.16-6 One way analysis of question 7 (Appendix 7.7) by academic year (1 = 3rd, 2 = 4th, 3 = 5th)



Analysis of variance (Kruskal-Wallis) showed no significant differences (p=0.5926)

Table 8.16-7 Contingency analysis of question 10 by academic year

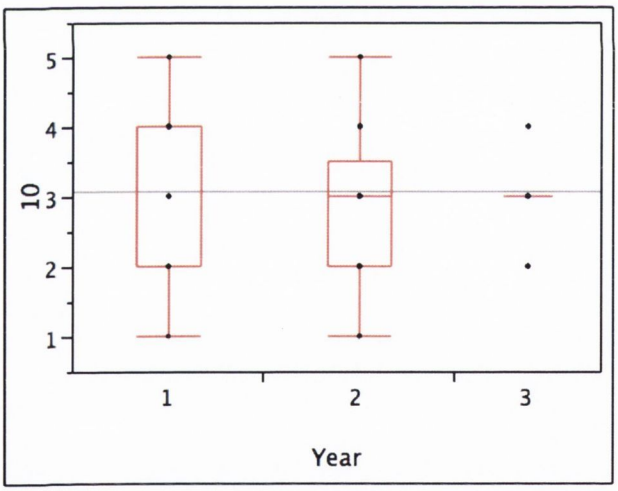
Count Col %	1	2	3	4	5	
3rd	1 33.33	8 36.36	7 18.92	14 58.33	3 60.00	33
4th	2 66.67	9 40.91	14 37.84	6 25.00	2 40.00	33
5th	0 0.00	5 22.73	16 43.24	4 16.67	0 0.00	25
	3	22	37	24	5	91

Chi-squared values

Test	Chi-squared	Prob>ChiSq
Pearson	15.605	**0.0484**

Significant association

Figure 8.16-7 One way analysis of question 10 by academic year (1 = 3rd, 2 = 4th, 3 = 5th)



Analysis of variance (Kruskal-Wallis) showed no significant differences (p=0.1624)

Table 8.16-8 Contingency analysis of question 11 by academic year

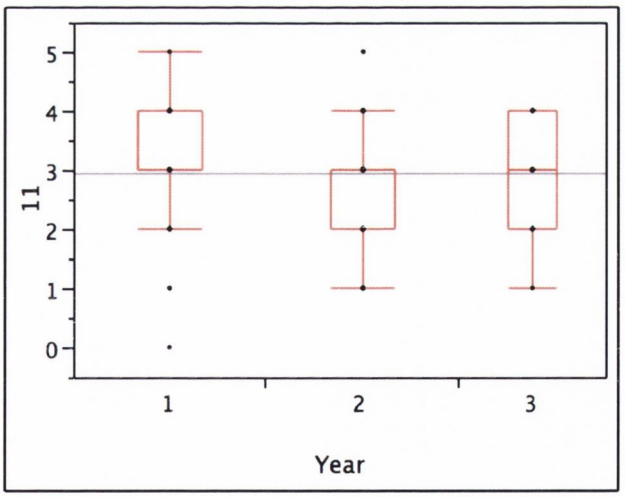
Count Col %	0	1	2	3	4	5	
3rd	1 100.00	2 28.57	4 19.05	10 31.25	15 53.57	1 50.00	33
4th	0 0.00	4 57.14	11 52.38	11 34.38	6 21.43	1 50.00	33
5th	0 0.00	1 14.29	6 28.57	11 34.38	7 25.00	0 0.00	25
	1	7	21	32	28	2	91

Chi-squared values

Test	**Chi-squared**	**Prob>ChiSq**
Pearson	12.027	**0.2833**

No significant association

Figure 8.16-8 One way analysis of question 11 by academic year (1 = 3rd, 2 = 4th, 3 = 5th)



Analysis of variance (Kruskal-Wallis) showed no significant differences (p=0.0565)

Table 8.16-9 Contingency analysis of question 12 by academic year

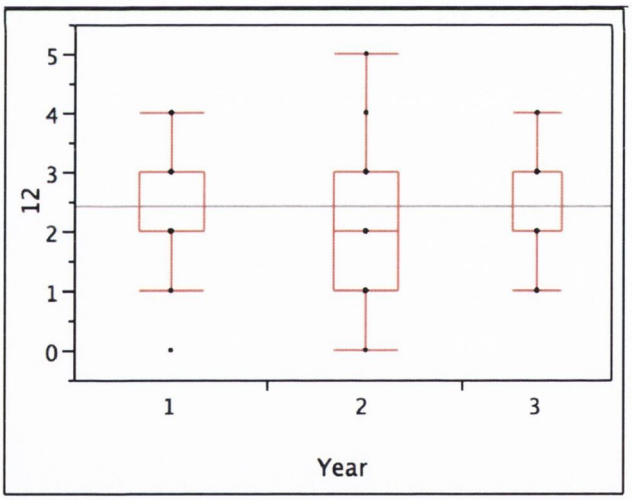
Count Col %	0	1	2	3	4	5	
3rd	1 50.00	1 7.14	17 53.13	8 25.81	6 54.55	0 0.00	33
4th	1 50.00	10 71.43	9 28.13	10 32.26	2 18.18	1 100.00	33
5th	0 0.00	3 21.43	6 18.75	13 41.94	3 27.27	0 0.00	25
	2	14	32	31	11	1	91

Chi-squared values

Test	**Chi-squared**	**Prob>ChiSq**
Pearson	20.167	**0.0277**

Significant association

Figure 8.16-9 One way analysis of question 12 by academic year (1 = 3rd, 2 = 4th, 3 = 5th)



Analysis of variance (Kruskal-Wallis) showed no significant differences (p=0.1157)

Table 8.16-10 Contingency analysis of question 13 by academic year

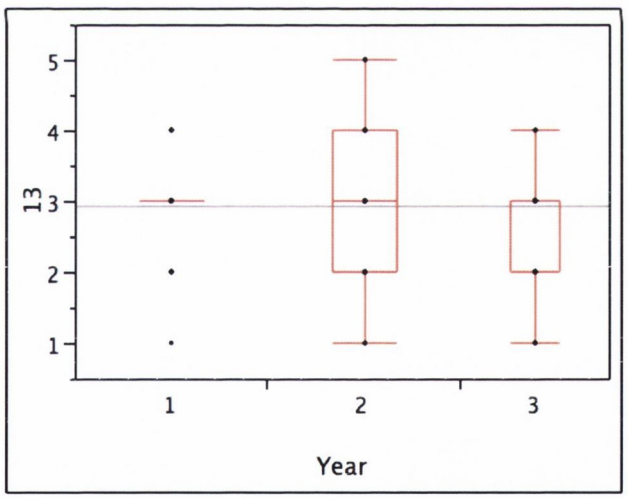
Count Col %	1	2	3	4	5	
3rd	1 16.67	5 27.78	20 42.55	7 41.18	0 0.00	33
4th	3 50.00	7 38.89	13 27.66	7 41.18	3 100.00	33
5th	2 33.33	6 33.33	14 29.79	3 17.65	0 0.00	25
	6	18	47	17	3	91

Chi-squared values

Test	**Chi-squared**	**Prob>ChiSq**
Pearson	9.300	**0.3177**

No significant association

Figure 8.16-10 One way analysis of question 13 by academic year (1 = 3rd, 2 = 4th, 3 = 5th)



Analysis of variance (Kruskal-Wallis) showed no significant differences (p=0.4074)

Table 8.16-11 Contingency analysis of question 14 by academic year

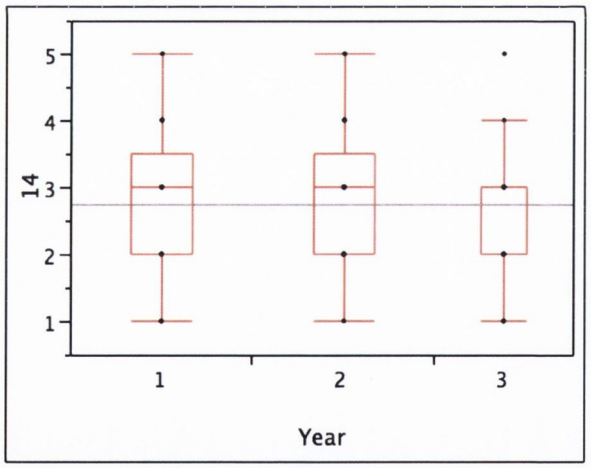
Count Col %	1	2	3	4	5	
3rd	4 50.00	10 30.30	11 35.48	6 46.15	2 33.33	33
4th	1 12.50	12 36.36	12 38.71	6 46.15	2 33.33	33
5th	3 37.50	11 33.33	8 25.81	1 7.69	2 33.33	25
	8	33	31	13	6	91

Chi-squared values

Test	**Chi-squared**	**Prob>ChiSq**
Pearson	5.435	**0.7103**

No significant association

Figure 8.16-11 One way analysis of question 14 by academic year (1 = 3rd, 2 = 4th, 3 = 5th)



Analysis of variance (Kruskal-Wallis) showed no significant differences (p=0.3409)

Table 8.16-12 Contingency analysis of question 15 by academic year

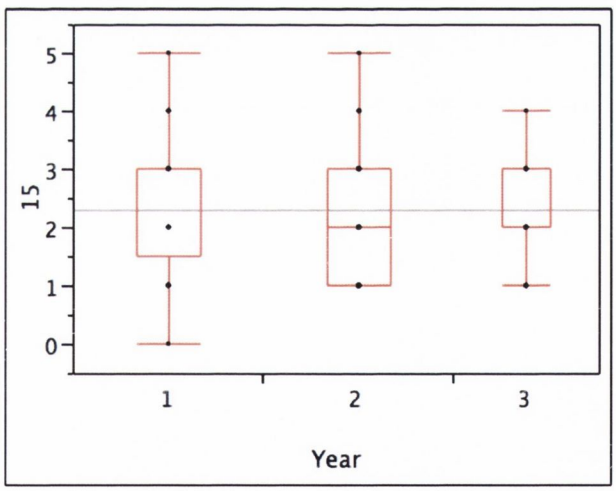
Count Col %	0	1	2	3	4	5	
3rd	1 100.00	7 29.17	6 22.22	13 46.43	5 55.56	1 50.00	33
4th	0 0.00	12 50.00	9 33.33	8 28.57	3 33.33	1 50.00	33
5th	0 0.00	5 20.83	12 44.44	7 25.00	1 11.11	0 0.00	25
	1	24	27	28	9	2	91

Chi-squared values

Test	**Chi-squared**	**Prob>ChiSq**
Pearson	11.984	**0.2861**

No significant association

Figure 8.16-12 One way analysis of question 15 by academic year (1 = 3rd, 2 = 4th, 3 = 5th)



Analysis of variance (Kruskal-Wallis) showed no significant differences (p=0.2544)

Table 8.16-13 Contingency analysis of question 16a by academic year

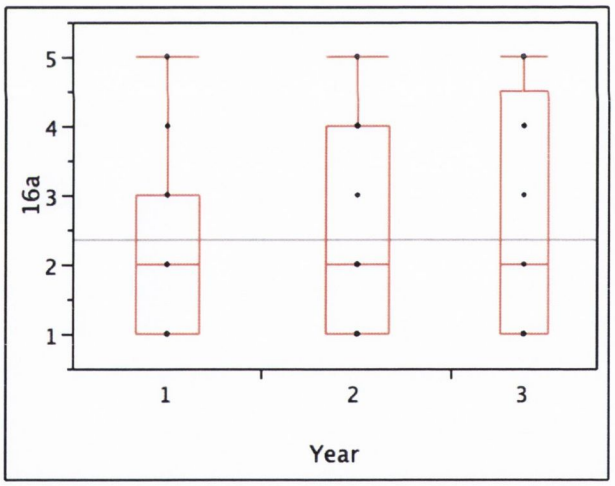
Count Col %	1	2	3	4	5	
3rd	14 37.84	9 42.86	4 50.00	3 21.43	3 27.27	33
4th	12 32.43	10 47.62	2 25.00	7 50.00	2 18.18	33
5th	11 29.73	2 9.52	2 25.00	4 28.57	6 54.55	25
	37	21	8	14	11	91

Chi-squared values

Test	**Chi-squared**	**Prob>ChiSq**
Pearson	10.175	**0.2530**

No significant association

Figure 8.16-13 One way analysis of question 16a by academic year (1 = 3rd, 2 = 4th, 3 = 5th)



Analysis of variance (Kruskal-Wallis) showed no significant differences (p=0.6359)

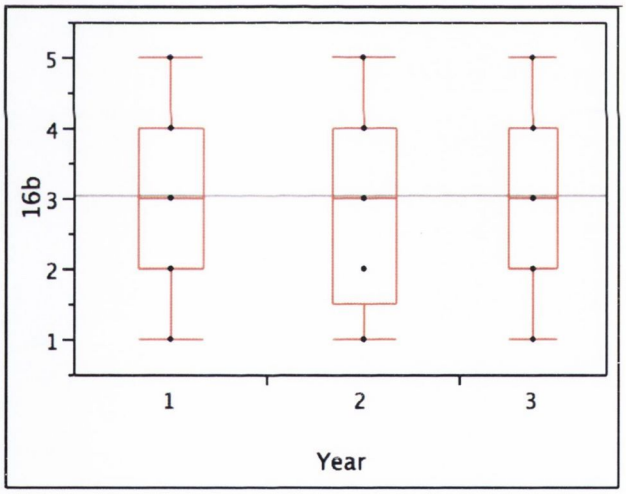
Table 8.16-14 Contingency analysis of question 16b by academic year

Count Col %	1	2	3	4	5	
3rd	4 25.00	6 35.29	7 31.82	9 45.00	7 43.75	33
4th	8 50.00	6 35.29	8 36.36	6 30.00	5 31.25	33
5th	4 25.00	5 29.41	7 31.82	5 25.00	4 25.00	25
	16	17	22	20	16	91

Chi-squared values

Test	**Chi-squared**	**Prob>ChiSq**
Pearson	2.807	**0.9459**

Figure 8.16-14 One way analysis of question 16b by academic year (1 = 3rd, 2 = 4th, 3 = 5th)



Analysis of variance (Kruskal-Wallis) showed no significant differences (p=0.3930)

Table 8.16-15 Contingency analysis of question 16c by academic year

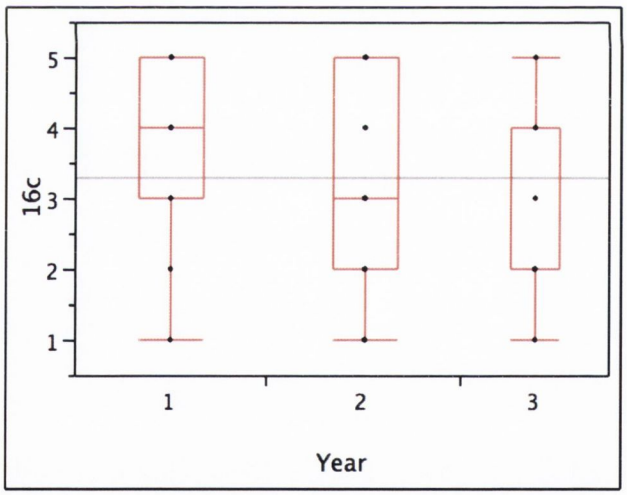
Count Col %	1	2	3	4	5	
3rd	3 25.00	3 15.79	5 31.25	10 52.63	12 48.00	33
4th	6 50.00	5 26.32	8 50.00	4 21.05	10 40.00	33
5th	3 25.00	11 57.89	3 18.75	5 26.32	3 12.00	25
	12	19	16	19	25	91

Chi-squared values

Test	**Chi-squared**	**Prob>ChiSq**
Pearson	17.423	**0.0260**

Significant association

Figure 8.16-15 One way analysis of question 16c by academic year (1 = 3rd, 2 = 4th, 3 = 5th)



Analysis of variance (Kruskal-Wallis) showed significant differences (p=0.0247)

Table 8.16-16 Contingency analysis of question 16d by academic year

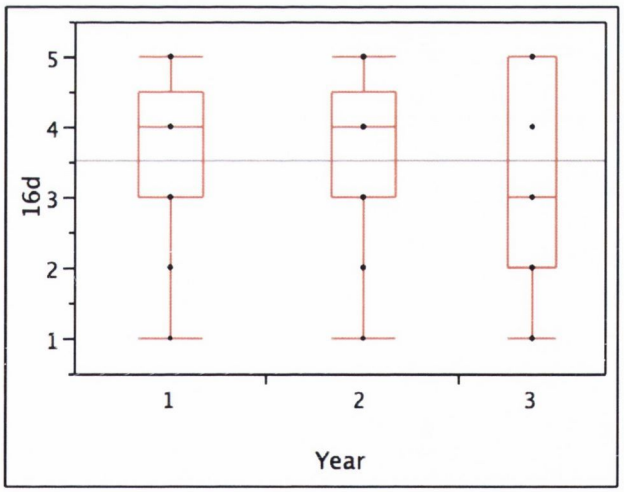
Count Col %	1	2	3	4	5	
3rd	1 16.67	4 30.77	10 43.48	10 38.46	8 34.78	33
4th	1 16.67	4 30.77	8 34.78	12 46.15	8 34.78	33
5th	4 66.67	5 38.46	5 21.74	4 15.38	7 30.43	25
	6	13	23	26	23	91

Chi-squared values

Test	**Chi-squared**	**Prob>ChiSq**
Pearson	8.253	**0.4091**

No significant association

Figure 8.16-16 One way analysis of question 16d by academic year (1 = 3rd, 2 = 4th, 3 = 5th)



Analysis of variance (Kruskal-Wallis) showed no significant differences (p=0.4576)

Table 8.16-17 Contingency analysis of question 16e by academic year

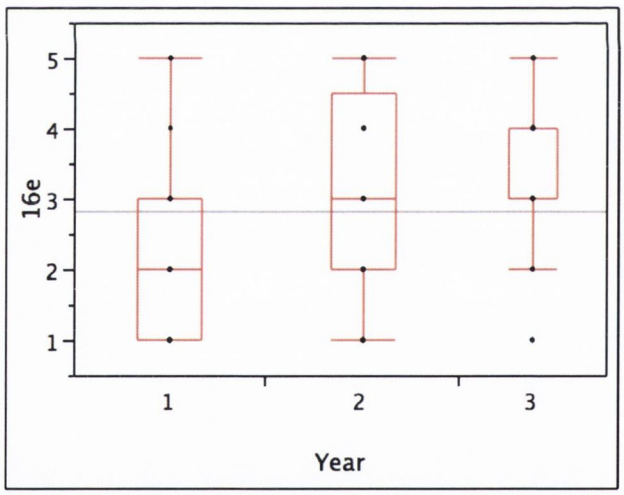
Count Col %	1	2	3	4	5	
3rd	11 55.00	11 52.38	7 31.82	1 8.33	3 18.75	33
4th	6 30.00	8 38.10	7 31.82	4 33.33	8 50.00	33
5th	3 15.00	2 9.52	8 36.36	7 58.33	5 31.25	25
	20	21	22	12	16	91

Chi-squared values

Test	**Chi-squared**	**Prob>ChiSq**
Pearson	17.183	**0.0283**

Significant association

Figure 8.16-17 One way analysis of question 16e by academic year (1 = 3rd, 2 = 4th, 3 = 5th)



Analysis of variance (Kruskal-Wallis) showed significant differences (p=0.0038)

Table 8.16-18 Contingency analysis of question 17a by academic year

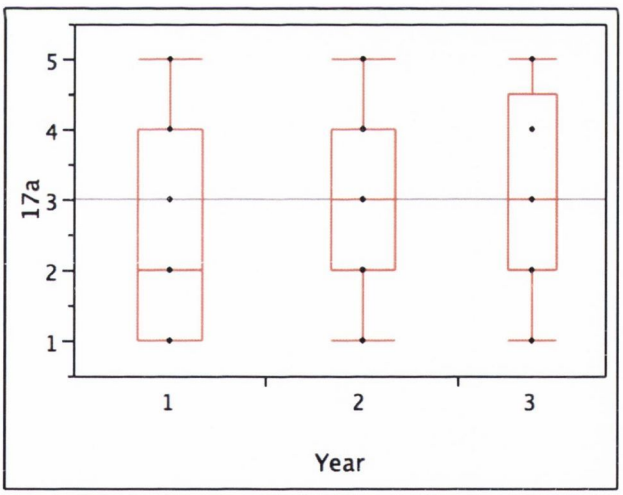
Count Col %	1	2	3	4	5	
3rd	9 52.94	9 47.37	6 31.58	4 21.05	5 29.41	33
4th	4 23.53	6 31.58	8 42.11	9 47.37	6 35.29	33
5th	4 23.53	4 21.05	5 26.32	6 31.58	6 35.29	25
	17	19	19	19	17	91

Chi-squared values

Test	Chi-squared	Prob>ChiSq
Pearson	6.087	0.6374

No significant association

Figure 8.16-18 One way analysis of question 17a by academic year (1 = 3rd, 2 = 4th, 3 = 5th)



Analysis of variance (Kruskal-Wallis) showed no significant differences (p=0.1226)

Table 8.16-19 Contingency analysis of question 17b by academic year

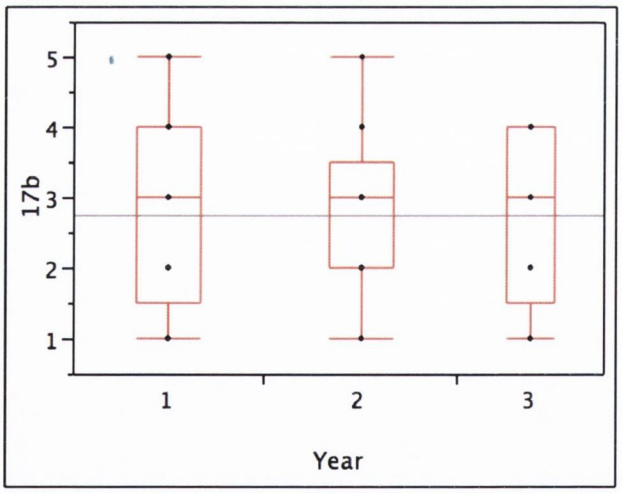
Count Col %	1	2	3	4	5	
1	8 44.44	8 34.78	5 23.81	8 34.78	4 66.67	33
2	4 22.22	10 43.48	11 52.38	6 26.09	2 33.33	33
3	6 33.33	5 21.74	5 23.81	9 39.13	0 0.00	25
	18	23	21	23	6	91

Chi-squared values

Test	Chi-squared	Prob>ChiSq
Pearson	9.661	0.2897

No significant association

Figure 8.16-19 One way analysis of question 17b by academic year (1 = 3rd, 2 = 4th, 3 = 5th)



Analysis of variance (Kruskal-Wallis) showed no significant differences (p=0.9871)

Table 8.16-20 Contingency analysis of question 17c by academic year

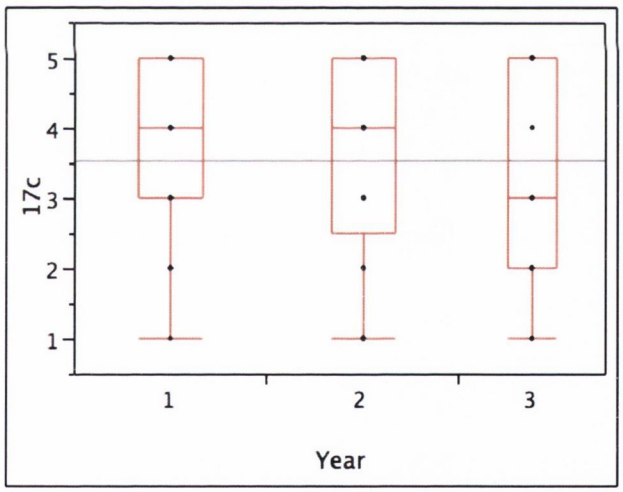
Count Col %	1	2	3	4	5	
1	1 12.50	6 37.50	8 47.06	8 40.00	10 33.33	33
2	5 62.50	3 18.75	5 29.41	10 50.00	10 33.33	33
3	2 25.00	7 43.75	4 23.53	2 10.00	10 33.33	25
	8	16	17	20	30	91

Chi-squared values

Test	**Chi-squared**	**Prob>ChiSq**
Pearson	10.405	0.2377

No significant association

Figure 8.16-20 One way analysis of question 17c by academic year (1 = 3rd, 2 = 4th, 3 = 5th)



Analysis of variance (Kruskal-Wallis) showed no significant differences (p=0.9646)

Table 8.16-21 Contingency analysis of question 17d by academic year

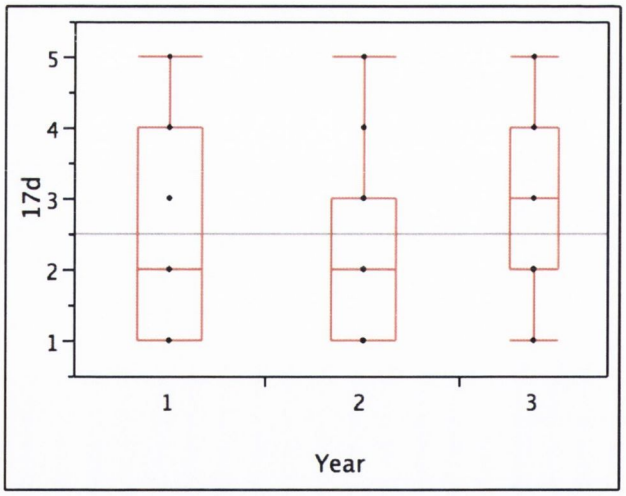
Count Col %	1	2	3	4	5	
3rd	10 33.33	7 35.00	7 43.75	7 43.75	2 22.22	33
4th	16 53.33	5 25.00	5 31.25	4 25.00	3 33.33	33
5th	4 13.33	8 40.00	4 25.00	5 31.25	4 44.44	25
	30	20	16	16	9	91

Chi-squared values

Test	Chi-squared	Prob>ChiSq
Pearson	9.254	0.3213

No significant association

Figure 8.16-21 One way analysis of question 17d by academic year (1 = 3rd, 2 = 4th, 3 = 5th)



Analysis of variance (Kruskal-Wallis) showed no significant differences (p=0.1113)

Table 8.16-22 Contingency analysis of question 17e by academic year

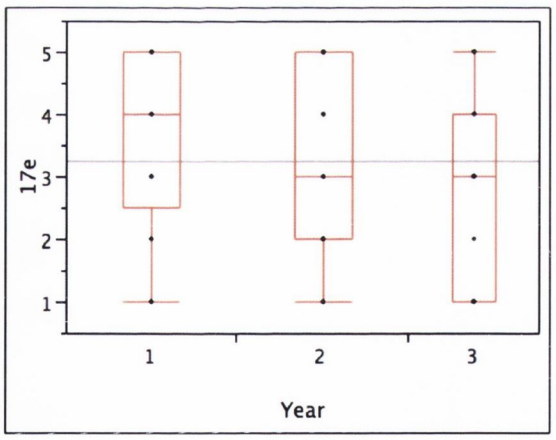
Count Col %	1	2	3	4	5	
3rd	5 27.78	3 23.08	7 38.89	6 46.15	12 41.38	33
4th	4 22.22	9 69.23	4 22.22	4 30.77	12 41.38	33
5th	9 50.00	1 7.69	7 38.89	3 23.08	5 17.24	25
	18	13	18	13	29	91

Chi-squared values

Test	Chi-squared	Prob>ChiSq
Pearson	14.973	0.0597

No significant association

Figure 8.16-22 One way analysis of question 17e by academic year (1 = 3rd, 2 = 4th, 3 = 5th)



Analysis of variance (Kruskal-Wallis) showed no significant differences (p=0.1620)

8.17 Publication details

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Clinical teaching in restorative dentistry and the variation between students' and supervisors' perceptions of its effectiveness

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9 References

Ackerman PL. Determinants of individual differences during skill acquisition: cognitive abilities and information processing. J Exp Psychol Gen 1998:117: 228-318.

Ackerman PL. Predicting individual differences in complex skill acquisition: dynamics of ability determinants. J Appl Psychol 1992:77:598-614.

Albanese MA, Mitchell S. Problem-based Learning: A review of literature on its outcomes and implementation issues. Acad Med 1993: 68: 52-81.

Albanese MA. Problem-based learning "why curricula are likely to show little effect on knowledge and clinical skills." Med Educ 2000: 34: 729-738.

Albano M, Cavallo GF, Hoogenboom R, Magni F, Majoor G, Manenti F, Schuwirth L, Stiegler I, van der Vleuten C. An international comparison of knowledge levels of medical students: the Maastricht Progress Test. Med Educ 1996: 30: 239-245.

Al Tahawi HM. Dental education: Mental vs Manual Dexterity? Saudi Dental Journal 1995: 7: 1-2.

Antepohl W, Herzig S. Problem based learning versus lecture based learning in a course of basic pharmacology: a controlled, randomised study. Med Educ 1999: 33: 106-113.

Atkinson RL, Atkinson RC, Smith EE, Bem DJ. Introduction to Psychology (10th edition), ISBN: 0155436880. Harcourt Brace Jovanovich, Florida, USA: 1993: 52-70.

Baca E, Mennin SP. "Comparison between a problem-based,

community oriented track and a traditional track within one medical school. In Nooman ZM, Schmidt HG, & Ezzat E.S, (Eds), Innovation in medical education: An evaluation of its present status. ISBN: 0826158501, New York: Springer: 1990: 9-26.

Bandura A. Self efficacy: The exercise of control. ISBN: 0716726262. W.H.Freeman, New York: 1997: 316-519.

Bandura A. Social foundations of thought and action: a social cognitive theory. ISBN: 013815614X. Prentice Hall, Englewood Cliffs, London: 1986: 206-208.

Bandura A, Walters R. Social learning and Imitation. New Haven, NJ: Yale University Press: 1963.

Barrows H. Foreword In: Evensen DH, Hmelo CE (eds). Problem-Based Learning: A Research Perspective on Learning Interactions. London UK: Lawrence Erlbaum Associates, Publishers: 2000: vii.

Barrows HS, Tamblyn RM. An evaluation of problem based learning in small groups utilizing a simulated patient. Journal of Medical Education 1976: 51: 52-54.

Berkson L. Problem-based learning: have the expectations been met? Acad Med 1993: 68(10 Suppl): S79-88.

Bialystok E. Communication strategies in second language acquisition. ISBN: 0631174575, Basil Blackwell, Oxford: 1990: 25-48.

Blake RL, Hosokawa MC, Riley SL. Student performances on Step 1 and Step 2 of the United States Medical Licensing Examination Folowing Imlementation of a Problem-based Learning Curriculum. Acad Med 2000: 75: 66-70.

Block SD, Moore GT. Project evaluation. In Tosteson DC, Adelstein

SJ, &. Carver ST. (Eds), New pathways to medical education: Learning to learn at Harvard Medical School. ISBN: 067461738X, Harvard University Press, Cambridge, MA: 1994: 38-114.

Bolles RC. Learning theory: (2nd edition), ISBN: 0030193060, Holt, Rinehart and Wilson, New York: 1979: 192-229.

Boshuizen HP, Schmidt H. Curriculum style and the integration of biomedical and clinical knowledge. Problem-based learning as an educational strategy, Eds. Bouhuys, PAJ, Schmidt H, and Van Berkel, Maastricht, Network publications: 1993: 33-41.

Bradford LP. The teaching-learning transaction. Adult Education 1958: 8:135-145.

Bressler SL. Understanding cognition through large scale cortical networks. Current Directions in Psychological science 2002: 11: 58-61.

Byrnes JP. Minds, brains and learning: Understanding the psychological and educational relevance of neuroscientific research. ISBN: 1572306513, Guilford Press, New York: 2001:10-65.

Carlson NR. Foundations of physiological psychology. ISBN 0205316212, Allyn & Bacon, Boston, London: 1999: xvi-128.

Castro-Caldas A, Miranda PC, Carmo I, Reis A, Leote F, Ribeiro C, Ducla-Soares E. Influence of learning to read and write on the morphology of the corpus callosum. European Journal of Neurology 1999: 6: 23-28.

Cervero, RM. Effective continuing education for professionals. ISBN: 155542127, Jossey-Bass Inc, San Francisco: 1988: 120-160.

Chambers DW, Geissberger M, Leknius C. Association amongst factors thought to be important by instructors in dental education and perceived effectiveness of these instructors by students. Eur J Dent Educ 2004: 8:147-151.

Chapnick LA, Chapnick A. Clinical undergraduate teaching. J Endod 1999: 25(10):686-688.

Chapple I. Questionnaire research: an easy option? British Dental Journal 2003: 195 (7): 359.

Chaiken SR, Kyllonen PC, Tirre WC. Organization and Components of psychomotor ability. Cognitive Psychology 2000: 40:198-226.

Clark JD, Robertson LJ, Harden RM. Applying learning outcomes to dental education. British Dental Journal 2004: 6:357-359.

Coles CR. Differences between conventional and problem based curricula in their students approaches to studying. Med Educ 1985: 19: 308-309.

Collier V. How long? A synthesis of research on academic achievement in a second language. TESOL Quarterly 1989: 23: 509-523.

Colliver J. Effectiveness of Problem-based Learning Curricula: Research and Theory. Acad Med 2000: 75: 259-266.

Copeland HL, Hewson MG. Developing and testing an instrument to measure the effectiveness of clinical teaching in an academic medical centre. Acad Med 2000: 75: 161-166.

Coy K, McDougall H, Sneed M. Issues regarding practical validity and gender bias of the perceptual abilities test (PAT). J Dent Educ 2003: 67: 31-37.

Curtiss S. Genie: A psycholinguistic study of a modern day "wild child": ISBN: 9780121963507, Academic Press, New York: 1977: 12-53.

de Andrés AG, Sánchez E, Hidalgo JJ, Díaz MJ. Appraisal of psychomotor skills of dental students at University Complutense of Madrid. Eur J Dent Educ 2004: 8: 24-30.

Department of Sociology, University College Dublin. Differences between the roles of traditional tutor and PBL tutor. www.ucd.ie. Last accessed 12th of Sep 2009.

Distlehorst LH, Robbs RS. A comparison of problem-based learning and standard curriculum students: Three years of retrospective data. Teaching and Learning in Medicine 1998: 10: 131-137.

Dochy F, Segers M, Van den Bossche P, Gijbels D. Effects of PBL: a meta-analysis. Learning and Instruction 2003: 13: 533-568.

Dolmans D. The effectiveness of PBL: the debate continues. Some concerns about the BEME movement. Med Educ 2003: 37: 1129-1130.

Driscoll MP. Psychology of learning for instruction. (3rd edition) ISBN: 9780205375196, Allyn & Bacon, Boston, MA: 2004: 34-35.

Eisenstaedt RS, Barry WE, Glanz K. Problem-based learning: Cognitive retention and cohort traits of randomly selected participants and decliners. Acad Med 1990: 65 (9 Sep. suppl): 11-12.

Elbert T, Pantev C, Taub, E. Increased cortical representation of the fingers of the left hand in string players. Science 1995: 270: 305-307.

Evans CE, Haynes RB, Birkett NJ, Gilbert JR, Taylor DW, Sackett DL, Johnston ME, Hewson SA. Does a mailed continuing education program improve physician performance? Results of a randomised trial in antihypertensive care. JAMA 1986: 255: 501-504.

Evans CE, Haynes RB, Gilbert JR, Taylor DW, Sackett DL, Johnston M. Educational package on hypertension for primary care physicians. CMAJ. 1984: 130: 719-22.

Farquhar LJ, Haf J, Kotabe K. Effect of two preclinical curricula on NMBE part I examination performance. Journal of Medical Education 1986: 61: 368-373.

Ferguson KJ. Problem-based learning: let's not throw the baby out with the bathwater. Med Educ 2005: 39: 352-353.

Friedman A. Framing pictures: The role of knowledge in automatized encoding and memory for gist. Journal of Experimental Psychology. 1979: 108: 316-355.

Fugill M. Teaching and learning in dental student clinical practice. Eur J Dent Educ 2005: 9: 131-136.

Gansky SA, Pritchard H, Kahl E, Mendoza D, Bird W, Miller AJ, Graham D. Reliability and validity of a manual dexterity test to predict preclinical grades. J Dent Educ 2004: 68: 985-994.

GDC. The first five years. London: General Dental Council, 2002.

Gillet D, Quinton A, Jeannel A. Is there a link between writing ability, drawing aptitude and manual skills of dental students? Eur J Dent Educ 2002: 6: 69-73.

Giuliani M, Lajolo C, Clemente L, Querqui A, Viotti R, Boari A, Miani CM. Is manual dexterity essential in the selection of dental students? Br Dent J 2007: 203: 149-155.

Goldman-Rakic PS. Working memory and the mind. Scientific American 1992: 90: 111-117.

Goldman-Rakic PS. Setting the stage: Neural development before birth. In. Friedman SL, Klivington KA, &. Peterson RW. The brain,

cognition and education, ISBN: 9780122683305, Academic Press, Orlando, FL: 1986: 25-38.

Good TL, Brophy JE. Educational psychology: A realistic approach. (4th edition) ISBN: 0801303516. Longman, White Plains, New York: 1990: 180-199.

Goodman LJ, Brueschke EE, Bone RC, Rose WH, Williams EJ, Paul HA. An experiment in medical education. A critical analysis using traditional criteria. JAMA 1991: 265: 2373-2376.

Goodman GS, Tessier-Lavigne M. Molecular mechanisms of axon guidance and target recognition. In Cowan WM, Jessell TM & Zipursky SL. (Eds.), Molecular and Cellular approaches to neural development. ISBN 0195111664, Oxford University Press, New York: 1997: 108-137.

Gosling D and Moon J (2001). How do we use Learning Outcomes and Assessment Criteria? London: SEEC Office.

Gravani MN. From courses to processes: Teachers' and tutors' experiences and perceptions of an in-service training course in Greece. PhD thesis. University of Bristol, UK: 2003: 1-8.

Gray SA, Deem LP, Straja SR. Are traditional cognitive tests useful in predicting clinical success? J Dent Educ 2002: 66: 1241- 1245.

Gray SA, Deem LP. Predicting student performance in preclinical technique courses using the theory of ability determinants of skilled performance. J Dent Educ 2002: 66: 721-727.

Greenough WT, Black JE, Wallace CS. Experience and brain development. Child development 1987: 58: 539-559.

Gurpinar E, Musal B, Aksakoglu G, Ucku R. Comparison of knowledge scores of medical students in problem-based learning and

traditional curriculum on public health topics. BMC Med Educ 2005: 5: 7.

Harvey BJ, Rothman AI, Frecker RC. Effect of an Undergraduate Medical Curriculum on Student's Self Directed Learning. Acad Med 2003: 78: 1259-1265.

Henzi D, Davis E, Jasinevicius R, Hendricson W. North American dental students' perspectives about their clinical education. J Dent Educ 2006: 70: 361-377.

Hmelo CE, Gotterer GS, Bransford JD. A theory driven approach to assessing the cognitive effects of PBL. Instructional Science 1997: 25: 387-408.

Hmelo CE. Problem-based learning: Effects on the early acquisition of cognitive skill in medicine. The Journal of the Learning Sciences 1998: 7: 173-208.

Hmelo-Silver CE, Barrows HS. Goals and strategies of a problem-based learning facilitator. Interdisciplinary Journal of Problem-based Learning, 2006: 1: 21-39.

Hoban, G.F. Teacher learning for educational change: A systems thinking approach. ISBN: 0335209548, Open University Press, Buckingham: 2002: 57-86.

Hoyle E. and John P. Professional Knowledge and professional Practice. ISBN: 0304329177, Cassell, London: 1995: 162-177.

Imbos T, Drukker J, van Mameren H, Verwijnen M. The growth in knowledge of anatomy in a problem based curriculum. In. Schmidt HG & de Volder M L (Eds.). Tutorials in problem-based learning. New direction in training for the health professions. Assen: Van Gorcum: 1984: 106-115.

Iputo JE, Kwizera E. Problem- based learning improves the academic performance of medical students in South Africa. Med Educ 2005: 39: 399-393.

Jones A, McArdles PJ, O'Neill PAO. Perceptions of how well graduates are prepared for the role of pre-registration house officer: a comparison of oucomes from a traditional and an integrated PBL curriculum. Med Educ 2002: 36: 16-25.

Jones JW, Bieber LL, Echt, R, et al. A problem based curriculum, ten years of experience. In Schmidt HG & de Volder ML (Eds), tutorials in problem based learning. New direction in training for health professions. Assen: Van Gorcum: 1984: 181-198.

Kaufman A, Mennin S, Waterman R, Duban S, Hansbarger C, Silverblatt H, Obenshain SS, Kantrowitz M, Becker T, Samet J, Wiese W. The New Mexico experiment: educational innovation and institutional change. Acad Med 1989: 64: 285-294.

Kaufman D M, Mann KV. Comparing achievement on the medical council of Canada qualifying examination Part I of students in conventional and Problem-based Learning curricula. Acad Med 1998: 73: 1211-1213.

Kennedy D. Writing and using learning outcomes: A practical guide. Cork: Quality Promotion Unit, UCC.

Kidd EAM, Smith BGN, Pickard HW. Pickard's manual of operative dentistry. Oxford: Oxford University Press, 1996: 112-113.

Koh GC, Khoo HE, Wong ML, Koh D. The effects of problem based learning during medical school on physician competency: a systematic review. CMAJ 2008: 178: 34-41.

Kuhl PK, Wiilliams KA, Lacerda F. Linguistic experience alters phonetic perceptions in infants by 6 months of age. Science 1992: 255: 606-608

Kuhl PK, Tsao FM, Liu HM. Foreign language experience in infancy:Effects of short term exposure and social interaction on phonetic learning. Proceedings of the national academy of sciences, 2003: 100: 9096-9101.

Larochelle M, Bednarz N, Garrison J. Constructivism and education. Cambridge University press. UK: 1998: 3-20.

Last KS, Appleton J, Stevenson H. Basic science knowledge of dental students on conventional and problem-based learning (PBL) courses at Liverpool. Eur J Dent Educ 2001: 5: 148-154.

Leonard DC. Learning theories A to Z. ISBN: 1573564133, Greenwood Press Westport, Connecticut • London: 2002: 6-94.

Login GR, Ransil BJ, Meyer M, Truong NT, Donoff RB, McArdle PJ. Assessment of preclinical problem-based learning versus lecture-based learning. J Dent Educ 1997: 61: 473-479.

Luck O, Reitemeier, B, Scheuch K. Testing of fine motor skills in dental students. Eur J Dent Educ 2004: 4: 10-14.

Lundergan WP, Soderstrom EJ, Chambers DW. Tweezer dexterity aptitude of dental students. J Dent Educ 2007: 71:1091-1097.

Mamede S, Schmidt HG, Norman GR. Innovations in Problem-based Learning: What can we Learn from Recent Studies? Adv Health Sci Educ Theory Pract 2006: 11: 403-422.

Mann RD, Arnold S, Binder J, Cytrynbaum S, Newman BM, Ringwald B, Ringwald J, Rosenwein R. The College Classroom: Conflict, Change and Learning. ISBN: 0471567124, John Wiley, New York: 1970: 285-388.

Manogue M, Brown G. Managing the curriculum – for a change. Eur J Dent Educ. 2007: 11: 75-86.

Manogue M, Brown G, Foster H. Clinical assessment of dental students: values and practices of teachers in restorative dentistry. Med Educ 2001: 35: 364-370.

Mattheos N, Schoonheim-Klein M, Walmsley A.D, Chapple I. Innovative educational methods and technologies applicable to continuing professional development in periodontology. Eur J Dent Educ 2010: (Suppl 1):43-52.

Mattheos N, Schittek M, Attström R, Lyon HC. Distance learning in academic health education. A literature review. Eur J Dent Educ. 2001: 5: 67-76.

McCall R.B, Carriger M.S. A meta-analysis of infant habituation and recognition memory performance as predictors of later IQ. Child Development. 1993: 64: 57-59.

McGrath C, Wai Kit Yeung R, Comfort MB, Mc Millan AS. Development and evaluation of a questionnaire to evaluate clinical dental teachers (ECDT). Br Dent J 2005: 198: 45-48.

McParland M, Noble LM, Livingstone G. The effectiveness of problem-based learning compared to traditional teaching in undergraduate psychiatry." Med Educ 2004: 38: 859-867.

Mennin SP, Friedman M, Skipper B, Kalishman S Snyder J. Performances on the NBME I, II, and III by medical students in the problem-based learning and conventional tracks at the University of New Mexico. Acad Med 1993: 68: 616-624.

Mennin SP, Kalishman S, Friedman M, Pathak D, Snyder J. A survey of graduates in practice from the University of New Mexico's conventional and community-oriented Problem-based Tracks. Acad

Med 1996: 71: 1079-1089.

Merrill MD. "A pebble-in-the-pond model for instructional design". Performance Improvement 2002: 41: 39-44.

Merrill MD. A Task-Centered Instructional Strategy. "Journal of Research on Technology in Education 2007: 40: 33-50.

Michel MC, Bischoff A, Zu Heringdorf M, Neumann D, Jakobs KH. Problem- vs. lecture-based pharmacology teaching in a German medical school. Naunyn Schmiedebergs Arch Pharmacol 2002: 366: 64-68.

Moore GT, Block SD, Style CB, Mitchell R. The influence of the New Pathway curriculum on Harvard medical students. Acad Med 1994: 69: 983-989.

Morrison J. Where now for problem based learning. Lancet 2004: 363: 174.

Nash DA. The life-long learning imperative... Ends and Means. J Dent Educ. 1994: 58: 785-790.

Neufeld V, Sibley J. 'Evaluation of health sciences education programs: programme and student assessment at McMaster University'. New directions for medical education: PBL and community oriented medical education, Eds. Schmidt, H., Lipkin, J.R., De Vries, M., and De Greep, J., (New York: Springer Verlag): 1989: 165-179.

Newman M, van den Bossche P, Gijbels, D, McKendree J, Roberts T, Rolfe I, Smucny J, De Virgilio G. Responses to the pilot systematic review of problem-based learning. Medical Education 2004:38: 921-926.

Newman M. Campell Collaboration Systematic Review Group on the

Effectiveness of Problem-based Learning. A pilot systematic review and meta-analysis on the effectiveness of problem based learning. Newcastle upon Tyne (UK): University of Newcastle upon Tyne: 2003.

Newport EL. Maturational constraints on language learnings. Cognitive Science 1990 :14: 11-28.

Nicholls JG. Repair and regeneration of the nervous system. Springer, Berlin: 1982: 57-69.

Nolte J, Eller P, Ringel SP, et al. Shifting toward problem-based learning in a medical school neurobiology course. Res Med Educ 1988: 27: 66-71.

Norman G, Schmidt H. Effectiveness of problem based learning curricula: theory, practice and paper darts Med Educ 2000: 34: 721-728.

Norman GR, Schmidt HG. The psychological basis of problem-based learning: a review of the evidence. Acad Med 1992: 67: 557-565.

Oliver R et.al. Curriculum structure: principles and strategy. Eur J Dent Educ 2008: 12 (Suppl. 1), 74-84.

Ormrod JE. Human Learning. (4th edition), ISBN: 0130941999, Harlow Prentice Hall: 2003: 150-187.

Oudshoorn WC. The utility of Canadian DAT perceptual ability and carving dexterity scores as predictors of psychomotor performance in first year operative dentistry. J Dent Educ 2003: 67: 1201-1208.

Park SE, Susarla SM, Massey W. Do admissions Data amd NBDE Part I scores predict clinical performance among dental students? J Dent Educ 2006: 70: 518-524.

Peng WW. Self- Directed learning: a matched control trial. Teach Learn Med 1989: 1: 78-81.

Peters AS, Greenberger-Rosovsky R, Crowder C, Block SD, Moore GT. Long-term outcomes of the New Pathway Program at Harvard Medical School: a randomised controlled trial. Acad Med 2000: 75: 470-479.

Phillips DC, Soltis JF. Perspectives on Learning, Chapter 3. Teachers College Press: 2004.

Phipps GT, Fishman R, Scott RH. Prediction of success in a dental school. J Dent Educ 1968: 32: 161-167.

Plasschaert AJ, Manogue M, Lindh C, McLoughlin J, Murtomaa H, Nattestad A, Sanz M. Curriculum content, structure and ECTS for European dental schools. Part II: methods of learning and teaching, assessment procedures and performance criteria. Eur J Dent Educ. 2007: 11: 125-36.

Prideaux D. Researching the outcomes of educational interventions: a matter of design. BMJ 2002: 324: 126-127.

Prince KJ, van Eijs PW, Boshuizen HP, van der Vleuten CP, Scherpbier AJ. General competencies of problem-based learning (PBL) and non-PBL graduates. Med Educ 2005: 39: 394-401.

Quinn F, Keogh P, McDonald A, Hussey D. A pilot study comparing the effectiveness of conventional training and virtual reality simulation in the skills acquisition of junior dental students. Eur J Dent Educ 2003a: 7: 13-19.

Quinn F, Keogh P, McDonald A, Hussey D. A study comparing the effectiveness of conventional training and virtual reality simulation in the skills acquisition of junior dental students. Eur J Dent Educ 2003b: 7: 164-169.

Ramsey PG, Carline JD, Inui TS, Larson EB, LoGerfo JP, Norcini JJ, Wenrich MD. Changes over time in the knowledge base of practicing internists. JAMA 1991: 266: 1103-7. Erratum in: JAMA 1991: 266: 3131.

Rich SK, Keim RG, Shuler CF. Problem-based learning versus a traditional educational methodology: a comparison of preclinical and clinical periodontics performance. J Dent Educ 2005: 69: 649-662.

Richards BF, Ober KP, Cariaga-Lo L, Camp MG, Philp J, McFarlane M, Rupp R, Zaccaro DJ. Ratings of students' performances in a third-year internal medicine clerkship: a comparison between problem-based and lecture-based curricula. Acad Med 1996: 71: 187-189.

Rolfe IE, Andren JM, Pearson S, Hensley MJ, Gordon JJ. Clinical competence of interns. Programme Evaluation Committee (PEC) Med. Educ 1995: 29: 225-230.

Santos-Gomez L, Kalishman S, Rezler A, Skipper B, Mennin SP. Residency performance of graduates from a problem-based and a conventional curriculum. Med Educ 1990: 24: 366-375.

Schittek M, Mattheos N, Lyon HC, Attström R. Computer assisted learning. A review. Eur J Dent Educ. 2001: 5: 93-100.

Schmidt HG, Machiels-Bongaerts M, Hermans H, ten Cate TJ, Vanekamp R, Boshuizen HP. The development of diagnostic competence: Comparison of a problem-based, an integrated,and a conventional medical curriculum. Acad Med 1996: 71: 658-664.

Schmidt HG, Vermeulen L, van der Molen HT. Long term effects of Problem Based Learning: a comparison of competencies acquired by graduates of a problem based and conventional medical school. Med Educ 2006: 40: 562-567.

Schmidt HG. Problem-based learning: does it prepare medical students to become better doctors? Med J Aust. 1998: 168: 429-430.

Schmidt HG. Foundations of problem-based learning: some explanatory notes. Med Educ 1993: 27: 422-432,

Schöenefeld D. Corpus linguistics and cognitivism. International journal of corpus linguistics 1999: 4: 131-171.

Schönwetter DJ, Lavigne S, Mazurat R Nazarko O. Students' perceptions of effective classroom and clinical teaching in dental and dental hygiene education. J Dent Educ 2006: 70: 624-635.

Schwartz LP, Egan AG, Heath CJ. How one school obtained the benefits of Problem based learning without Revolution. Acad Med 1993: 68: 612-613.

Schwartz RW, Burgett JE, Blue AV, Donnelly MB, Sloan DA. PBL and performance-based testing: Effective alternatives for undergraduate surgical education and assessment of student performance. Medical Teacher 1997: 19: 19-23.

Shin JH, Haynes BR, Johnston ME. "Effect of problem-based, self-directed undergraduate education on life-long learning." CMAJ 1993: 148: 969-976.

Shmidt HG, Vermeulen L, van der Molen H. Longterm effects of problem-based learning: a comparison of competencies acquired by graduates of a problem-based and a conventional medical school. Med Educ 2006: 40: 562-567.

Shuler CF, Fincham AG. Comparative achievement on national dental board examination Part I between dental students in problem based learning and traditional educational tracks. J Dent Educ 1998: 62: 666-670.

Smith RM. The learning-how-to-learn concept: Implications and Issues. In R. M. Smith (Eds.), Helping Adults Learn How To Learn. ISBN: 0875899459, Jossey-Bass Inc., San Francisco CA: 1983: 97 - 103

Smits PBA, Verbeek JHAM, de Buisonjé CD. Problem based learning in continuing medical education: a review of controlled evaluation studies. BMJ 2002: 325: 153-156.
Stepien WJ, Gallagher SA. "Problem-based learning: As authentic as it gets". Educational leadership 1993: 50: 25-28.

Summitt JB, Robbins JW, Schwartz RS. Fundamental of operative dentistry. ISBN: 0867154527, Quintessence Publishing Co. Inc, Chicago: 2001: 306-313.

Sweller J, Cooper GA. The use of worked examples as a substitute for problem solving in algebra. Cognition and instruction 1985: 2: 59-89

Sweller J. Cognitive load during problem solving: Effects on learning, Cognitive Science 1988: 12: 257-285.

Sweller J. "The worked example effect and human cognition". Learning and Instruction 2006: 16: 165-169.

Tamblyn R, Abrahamowicz M, Dauphinee D, Girard N, Bartlett G, Grand'Maison P, Brailovsky C. Effect of a community oriented problem based learning curriculum on quality of primary care delivered by graduates: historical cohort comparison study. BMJ 2005: 331: 1002-1005.

Tans RW, Schmidt HG. Sturing van het onderwijsleerproces door middel van problemen:een veldexperiment (Guiding the learning process by means of problems: A field experiment). Tijdschrift voor Onderwijsresearch 1986: 11: 35-46.

Tolnai S. "Continuing medical education and career choice among graduates of problem-based and traditional curricula." Med Educ

1991: 25: 414-420.

Torgerson C. Educational research and randomised trials. Med Educ 2002: 36: 1002-3.

Tronstad L, Leidel TI. Scanning electron microscopy of cavity margins finshed with chisels or rotating instruments at low speed. J Dent Res. 1973: 53: 1167-1174.

www.farmasi.uio.no/vett/Jubileum/Silva.pdf. Continuing education, continuing professional development & life long learning definitions. Dept. Of Pharmacy. University of Oslo, Oslo, 2006.

www.ucd.ie. Dept. Of Sociology. Problem Based Learning at UCD, Belfield, Dublin. 2003.

Ullian JA. Medical student and resident perceptions of clinical teaching. Healthcare Chapter News (National Society for Performance and Instruction) 1986: 1: 4-5.

van Berkel H, Schmidt. On the additional value of lectures in a problem-based curriculum. Education for Health 2005: 18:45-6.

Verhoeven BH, Verwijnen GM, Scherpbier AJJA, Holdrinet RSG, Oeseburg B, Bulte JA, Van Der Vleuten CPM. An analysis of progress test results of PBL and non-PBL students. Medical Teacher 1998: 20: 310-316.

Vernon D, Blake R. Does Problem-based Learning work? A meta-analysis of evaluative research. Acad Med 1993: 68: 550-63.

Wanzel KR, Hamstra SJ, Caminiti MF, Anastakis DJ. Grober ED, Reznick RK. Visual-spatial ability correlates with efficiency of hand motion and successful surgical performance. Surgery 2003: 134: 750-757.

Whaley SE, Sigman M, Espinosa MP Neumann CG. Infant predictors of cognitive development in an undernourished Kenyan population. Journal of developmental and behavioural paediatrics 1998: 19: 169-177.

Winning T, Townsend G. Problem-based learning in dental education: what's the evidence for and against...and is it worth the effort? Australian Dental Journal 2007: 52: 2-9.

Woodward CA, McAuley RG. Can the academic background of medical graduates be detected during intership? Canadian Medical Association Journal 1983: 129: 567-569.

Woolley S, Emanuel C, Koshy B. A pilot study of the use and perceived utility of a scale to assess clinical dental teaching within a UK dental school restorative department. Eur J Dent Educ 2009: 13: 73-79.

Youngson C, Fox K, Boyle E, Blundell K, Baker R. Improving the quality of clinical teaching in a restorative clinic using student feedback. Eur J Dent Educ 2008: 12:75-79.