

ORIGINAL RESEARCH ARTICLE

A Comparative Study of Performance of the Medical Students of Nepal in Anatomy on the Basis of PBL and Traditional Teaching

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Received 24 Sep 2012; Revised 05 Feb 2013; Accepted 14 Feb 2013

ABSTRACT

Innovations in undergraduate medical education, such as integration of disciplines and problem based learning, have given rise to concerns about students' knowledge of anatomy. This article originated from several studies investigating the knowledge of anatomy of students at five medical colleges of Nepal. The studies showed that undergraduate students uniformly perceived deficiencies in their anatomical knowledge when they started clinical training regardless of their college's didactic approach. A study assessing students' actual knowledge of clinical anatomy revealed no relationship between students' knowledge and the school's didactic approach. Test failure rates based on absolute standards set by different groups of experts were indicative of unsatisfactory levels of anatomical knowledge, although standards differed markedly between the groups of experts. Good test performance by students seems to be related to total teaching time for anatomy, teaching in clinical context, and revisiting anatomy topics in the course of the curriculum. These factors appeared to outweigh the effects of disciplinary integration or whether the curriculum was problem-based or traditional.

Key words: Anatomy teaching; Anatomy education; Problem-based learning; Integrated curriculum; Anatomical knowledge.

INTRODUCTION

The body of scientific knowledge has expanded dramatically over recent decades, with exponential increases in medical knowledge in nearly all disciplines. In the early 1980s, it was increasingly recognized that the body of information with potential relevance to medical practice was far too large for instructors to teach or for students to learn. To put it differently, it was rapidly becoming impractical to try and include everything in the undergraduate curriculum (Swanson and Case, 1997; Clough *et al.*, 2004; Woloschuk *et al.*, 2004). The current explosion of knowledge paradoxically coincides with a trend in many countries toward shorter undergraduate medical training programs. And if that is not bad enough, we know that there is a good chance that what students learn today will be outdated tomorrow: "we can be certain that the doctors of tomorrow will be applying knowledge and deploying skills which are at present

unforeseen" (General Medical Council, 1993). Therefore, the teaching of more generic competences, such as interpersonal skills and skills for lifelong learning, is being incorporated in medical education. But basic science education, with anatomy education in particular, is probably equally important: "Future developments in medical practice (e.g., diagnostic technology or surgical approaches) will best be dealt with by those who have a sound knowledge of the structure and function of the human body" (Monkhouse and Farrell, 1999). All these developments make it imperative that very careful consideration is given to what medical students need to learn and at which stage of the curriculum. Medical education has seen changes driven by evidence from the fields of psychology and education. Retention of knowledge is promoted when students are actively involved in their learning; this research finding supports the view

from cognitive psychology that learning is a constructive process in which learners connect new information to their existing knowledge networks, thereby forming and strengthening meaningful connections between concepts (Regehr and Norman, 1996). This process is optimized when prior knowledge is activated and students elaborate on, discuss, and explain (new) information, for instance, in groups of peers. As a result of this, today, many medical colleges have incorporated active learning methods into their courses (Dolmans *et al.*, 2005). Another influential finding is that knowledge retrieval is facilitated when knowledge is acquired in a situation resembling those in which it will be applied (Smith and Vela, 2001). Thus, learning based on authentic tasks is expected to facilitate the transfer of knowledge from educational settings to work settings. In order to achieve this, there is a growing tendency to enable students to deal with patient problems early in their studies or even to offer them early contacts with patients (Dornan *et al.*, 2006). This educational insight also explains the movement toward horizontal and vertical integration of disciplines in medical curricula. Horizontal integration refers to the integration of different basic science disciplines in one course, while vertical integration is the integration of basic and clinical sciences aimed at presenting basic sciences in context (Dahle *et al.*, 2002). Apart from disciplinary integration, other didactic approaches have left their mark on medical education. A shift is noticeable from “traditional” teacher-centered education, relying heavily on lectures with students as passive recipients of information, to “innovative” student-centered education focused on active, self-directed learning by students either individually or in groups. Today, student-centered learning approaches are being implemented by more and more medical colleges around the world (van der Vleuten *et al.*, 1996). The rapid rise of integrated curricula and approaches that are a departure from traditional didactic methods has given rise to concern about the level of knowledge attained by students graduating from innovative programs, for basic sciences in general, and for anatomy in particular. However, concerns of teachers and clinicians are mostly anecdotal and expressed informally. Anatomists (and surgeons involved in the higher surgical examinations) have commented on the decline of students’ knowledge and their lack of understanding of anatomy in discussions, anatomical meetings, and other

forums (Heylings, 2002). “The students’ knowledge of anatomy is lamentable. I cannot ignore this remark because I hear an increasing number of clinicians in say it” (Monkhouse, 1992). Waterston and Stewart (2005) gathered clinicians’ opinions on this subject with a survey. Their results indicate that the majority of clinicians believe that anatomy is not adequately taught, and as a result, students’ knowledge is below the minimum necessary for safe medical practice. With this article we want to contribute to the debate on the current situation in undergraduate anatomy education. Our contribution is found in our research addressing the questions of how much anatomical knowledge is enough and whether the levels of students’ anatomical knowledge are related to the use of innovative or traditional educational approaches. Additionally, we will explore which educational strategies may offer the best chance of raising the level of anatomical knowledge, both in volume and in detail.

DO PROBLEM-BASED LEARNING STUDENTS HAVE ACTUAL OR ONLY PERCEIVED DEFICIENCIES IN ANATOMICAL KNOWLEDGE?

True problem-based learning (PBL) curricula are characterized by full horizontal and vertical integration and self-directed learning. From the start of undergraduate training, students tackle authentic problems and are offered ample experience with clinical practice. Students work in small (tutorial) groups, with teachers as facilitators of the learning process. Many other so-called PBL curricula exist, in which different levels of application of the PBL format are supplemented with other didactic approaches. PBL, although being around for many years, is in general still labeled as one of the “innovative” didactic approaches. For the clarity of this article, (the mentioned) PBL curricula are not further discussed.

Students attending schools where PBL is the predominant approach have repeatedly stated that basic science knowledge is essential for their preparation for medical practice and that they find the programs of their schools wanting in this respect (Woodward, 1983; Prince *et al.*, 2000; Prince *et al.*, 2005a).

In a study by Prince *et al.* (2000), students in a PBL program reported a tendency in tutorial groups to skip the initial exploration of probable

causes and underlying mechanisms of a problem and start by looking up a diagnosis and its associated symptoms. Students said that even though the cases they were given to resolve were quite realistic, they managed to come up with the correct diagnosis within minutes and did not bother to formulate appropriate learning objectives. This may reflect a similar mechanism to that observed by O'Neill (2000), namely that in PBL a "potential disadvantage is that students may become more interested in the clinical aspects of a problem and neglect the underlying basic science knowledge, though this has not been formally reported." More importantly, he suggests that the focus on diagnostic problems in PBL interferes with the building of an appropriate conceptual framework, which students can use for continued learning of basic sciences. Drake (1999) also warns that some students may not do well in PBL (in its strictest form), because they are unable to cope with this type of self-directed learning. He also worries that some students will fill the gaps in their knowledge if left to their own devices. This may be important because "true understanding is defined not simply by the quantity of information that a person possesses, but by the extent to which this information is organized into a coherent, mutually supportive network of concepts and examples" (Regehr and Norman, 1996). In other words, without an appropriate framework, students' ability to retain and acquire basic science knowledge may be compromised.

These views are in contrast to claims that PBL stimulates retention and acquisition of basic science knowledge (continued learning). A number of reviews comparing the basic science knowledge of PBL-students and non-PBL-students (Albanese and Mitchell, 1993; Vernon and Blake, 1993; Alleyne *et al.*, 2002) yielded conflicting and inconclusive evidence. Some studies showed PBL graduates to have less basic science knowledge than traditionally trained students, whereas other studies reported no differences. With respect to anatomy, there is also an ongoing debate whether PBL can effectively replace traditional teaching. Of all basic sciences "anatomy, with a ~~wide~~ knowledge base, is probably the most resistant to change," since "PBL focuses more on understanding the material rather than reproducing and rote memorization" (Percac and Goodenough, 1998).

In order to substantiate perceived deficiencies in anatomical knowledge of PBL students, empirical studies have examined whether PBL and non-PBL students differed in self perceived knowledge of anatomy at the start of clerkships in undergraduate curriculum. It turned out that perceived insufficiency of anatomical knowledge was equally widespread among students of colleges with innovative and traditional curricula (Custers and Ten Cate, 2002; Prince *et al.*, 2003). Most students said they had learned less about anatomy than they deemed necessary and they expected to learn substantially more during the upcoming clerkships. Basically, all students were insecure about their level of anatomical knowledge and felt they did not know enough.

In a subsequent study, students' actual anatomical knowledge was assessed by a case-based anatomy test (questions about anatomy based on clinical cases) containing 100 multiple choice items. Interestingly, the differences between the colleges were significant. (Prince *et al.*, 2003). In all, this empirical verification points to the conclusion that differences between students in perceived and actual knowledge of anatomy are not related to innovative (PBL) or traditional curricula. Despite being clear, this is only partly a reassuring conclusion.

DO STUDENTS KNOW ENOUGH ABOUT ANATOMY?

The obvious question to ask next is whether students actually possess enough anatomical knowledge or not. But establishing how much anatomical knowledge is enough is not a straightforward matter. In a subsequent study we interpreted students' results on the case-based anatomy test, using standards arrived at by different groups of experts to determine whether the students knew enough or not, that is whether they passed or failed the test. Four expert panels consisting of fourth year students (other students than the ones sitting the clinical anatomy test), recently graduated doctors, clinicians (all from a different specialty), and anatomists (Prince *et al.* 2005b), respectively set a standard using a specific and rigorous item-by-item judgment procedure (Angoff procedure; Cusimano, 1996). Many students failed by the experts' standards, which differed markedly between the groups. Fourth year students set the most stringent standard, failing 64% of the students! Remember that our previous study revealed that fourth year students felt extremely uncertain about their

anatomical knowledge. The recently graduated doctors were most lenient, failing only 26% of the students. Apparently, expectations in this group had shifted following the reality check of completing undergraduate medical training. Interestingly, there was stronger agreement on the standard within this group than among the students. Next in leniency came the anatomists (failing 42%) followed by the clinicians (58%). Two conclusions stand out from this study: there is agreement that students' anatomical knowledge is unsatisfactory but no agreement on which level of knowledge is acceptable. Similar findings were reported for pharmacology and genetics (Vollebregt, 2004; Baars *et al.*, 2005). From this perspective, the problem does not just seem to be the deficiency of students' anatomical knowledge but a more general difficulty of establishing the minimal content of medical curricula and how much anatomical knowledge students should have at the end of undergraduate training.

Although attempts have been made (Leonard *et al.*, 1996; McHanwell *et al.*, 2007), these examples also show that consensus of what the minimal content should be does not exist at the moment. So far our explorations of undergraduate students' knowledge of anatomy have produced no evidence of a relationship between knowledge levels and innovative or traditional didactic educational approaches. At the start of undergraduate clinical training in Year 4, students of innovative and traditional colleges in the Nepal were equally worried about their presumably inadequate knowledge. They were probably right for, even by the most lenient standard, the anatomical knowledge of a quarter of the students was not up to the mark. This begs the question of what we can do to remedy this state of affairs. We have found some potential clues in different studies.

OTHER FACTORS AFFECTING STUDENTS' ANATOMICAL KNOWLEDGE

There are still other factors that may affect students' anatomical knowledge. One of these factors is "time on task." Complaints about the reduction in curricular time dedicated to anatomy and the shortage of suitable staff to teach anatomy have been reported before (Monkhouse, 1992; Pabst, 1993). When we explored the differences in knowledge between students from different colleges, we found that differences in the amount of time spent on anatomy covaried with students'

performance to some extent. It should not come as a surprise that spending more time on a subject results in more knowledge; time on task does indeed increase knowledge (Verhoeven *et al.*, 2002). But clearly in today's medical curricula, all disciplines are facing the problem of being allocated less time to cover more knowledge. Simply increasing time on task may be effective but it is just not feasible. So we need to explore further. Another factor that seemed to be associated with differences in anatomical knowledge was the frequency of their recurrence in the course of the curriculum. Like the effect of time on task, this too makes intuitive sense, and there is some evidence in the literature to support this (Blunt and Blizard, 1975). If revisiting topics is effective, this may imply that anatomy should not be presented in the curriculum as a one-shot event but distributed throughout the curriculum, with subject matter being revisited and extended repeatedly. Developing spiral curricula has been advocated in the literature (Harden *et al.*, 1984). However, while clinical topics are regularly integrated into the early years of medical curricula, integrating basic sciences in the later curricular years seems a tougher task (McCrorie, 2000; O'Neill, 2000; Prince *et al.* 2005b; Whitcomb, 2006). Whitcomb (2006) referred to a report of the Association of American Medical Colleges in 2001 stating that "colleges had not done enough to integrate content drawn from the biomedical sciences into the third and fourth years of the curriculum." The amount of time devoted to basic sciences is therefore perceived as being diminished, resulting in diminished growth and lower levels of basic science knowledge in students. Anatomy is the basic science for which concern about its continued place in any undergraduate curriculum is strongest (O'Neill, 2000). There is widespread support among clinicians for more vertical integration of anatomy teaching throughout the undergraduate curriculum (Waterston and Stewart, 2005).

Our exploration of anatomy training grew even more interesting when we found the highest levels of anatomical knowledge among the students who were taught anatomy in a clinically meaningful

context—such as patient problems, and diagnostic and therapeutic features. This was clearly true for the two schools with the best anatomy results in the comparison. At the time of the study, one of these schools offered a traditional and the other one a PBL curriculum, but they both taught anatomy in a clinical context. Possibly, the effects of clinically oriented teaching combined with recurrence of topics in the curriculum are more powerful than those of traditional or innovative didactics (Prince *et al.*, 2003).

IMPLICATIONS FOR ANATOMY TEACHING

Our explorations of the question of how much anatomical knowledge is enough and which educational strategies are likely to enhance anatomical knowledge have produced some interesting insights. First and foremost, PBL and traditional training do not have a differential impact on students' anatomical knowledge. PBL does not appear to be associated with more or less anatomical knowledge. For some, this may be reassuring, and for others disappointing. We must keep in mind however that PBL was not introduced to help students acquire larger amounts of knowledge but to foster their ability to apply what they have learned. More than other approaches, PBL is supposed to facilitate integration of students' knowledge, transfer of concepts to new problems, application of basic science concepts to clinical problems, intrinsic interest in subject matter and development of skills to solve problems, learning how to learn, self-directed learning, and motivation for lifelong learning (Norman and Schmidt, 1992; Dahle *et al.* 2002). There are some modest indications in the literature that PBL students perform better on clinical reasoning tasks (Schmidt *et al.*, 1996; Schuwirth *et al.*, 1999). Our exploration puts this claim in a slightly different light. It seems that the effects of certain educational principles are more powerful than those of didactic approaches, such as PBL or traditional lecture-based teaching. One of these principles seems to be the insight from cognitive psychology that learning is facilitated when it occurs in a meaningful context (Schmidt, 1993). Most PBL courses are characterized by contextual learning, but traditional, lecture-based curricula are equally suitable for presenting anatomy embedded in a clinical context. As discussed earlier, time on task and a spiral curriculum are other principles that seem to be making a difference too. If we wish to improve

our anatomy teaching, maybe we had better start looking to these principles. The second conclusion is that there is disagreement about how much anatomy is sufficient. Although there appears to be general agreement that there is room for improvement in students' anatomical knowledge, experts displayed disturbing discrepancies in their judgments of how much knowledge was enough. We question how realistic these expectations are. It is interesting to note the sharp distinction in standards set by fourth-year students and recently graduated doctors. On the brink of undertaking clinical responsibilities during clerkships, students appear to experience the strongest uncertainties and therefore may be inclined to make high demands on knowledge levels. The reality check of undergraduate clinical training appears to be reflected in the downward adjustment of the standards of the recent graduates. It is interesting that (in) security about knowledge is also not related to PBL. Of note were also the extreme expectations of the clinicians.

It makes one wonder whether students' insecurity is not partly fed by the expectations evinced by their teachers. In the absence of consensus among experts, we need to explore ways of developing guidelines that set out clearly what students are expected to know. Obviously, this will require extensive interdisciplinary discussions combined with reality checks to ensure that guidelines are underpinned by realistic expectations. The insecurity reported by students should be a stimulus to provide such guidelines. Finally, the marked differences in expectations between groups of experts may partly explain the inconclusive and varying results of previous research into the effectiveness of PBL in equipping students with basic science knowledge. Regardless of how much anatomy actually is enough, our explorations have revealed some indications as to how anatomy teaching can be improved.

RESULT-PERFORMANCE OF SECOND YEAR MEDICAL STUDENTS OF NEPAL IN PBL BASED TEST

Students of KU affiliated college were taught according to the PBL syllabus and students of TU affiliated college were taught according to the non PBL syllabus. Test was taken from all the students and the performance of the students of KU affiliated college was better than those of TU affiliated colleges. The KU students were also better in their presentation and way of dealing

with the patients. The result of the PBL based test in the respective University is listed as follows .The result was more than 53% success in KU

affiliated college ,and 29% success in the TU affiliated college.

Table 1: BPL based test result analysis

No of students	College/University	No of students passs	% Success	% Unsuces
150	Chitwan Medical College/ TU	20	13%	87%
150	National Medical College/TU	34	22%	78%
140	Janaki Medical College/TU	41	29%	71%
150	Nobel Medical College/KU	79	53%	47%
150	Nepalgunj Medical College/KU	87	58%	42%

CONCLUSION

So, we conclude that the KU affiliated college which is teaching according to PBL based syllabus, will produce better future doctors.

ACKNOWLEDGEMENT-

I am thankful to my department and all the faculties for their help and support for the work of this research.

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