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# Dimensions and psychology of peer teaching in medical education

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## Abstract

**Aim:** Peer teaching, an educational arrangement in which one student teaches one or more fellow students, is applied in several forms in medical education. A number of authors have linked peer teaching to theories of education and psychology. Yet no comprehensive overview of what theory can offer to understand dynamics of peer teaching has been previously provided.

**Method:** A framework is designed to categorize forms of peer teaching, distinguishing three dimensions: distance in stage of education, formality of the educational setting and size of the group taught. Theories are categorized in two dimensions: theories that explain benefits of peer teaching from a cognitive versus a social-psychological perspective, and theories that explain benefits for peer learners versus peer teachers.

**Conclusion:** Both dimensional frameworks help to clarify why and in what conditions peer teaching may help students to learn.



## Introduction

An overarching goal of medical education is progressive independence of the learner. While effective teaching is oriented toward the learning process, to foster independence (Ten Cate et al. 2004), learning may also gradually incorporate elements of teaching. A important skill for becoming an independent learner is the ability to self-reflect. Terms such as 'self-teacher', 'self-directed learner' or 'reflective practitioner' have been used in the literature to embody this needed skill. In this model of progressive independence, competence embodies a learner who is capable of bringing everything to the clinical encounter that is needed without formal guidance by a teacher. One potential way to learn to reflect and to teach oneself is by being a teacher for others.

Peer teaching can be defined as an educational arrangement in which one student teaches one or more fellow students. A 'near-peer teacher'—one of the most common forms of peer teaching–is a student who is more advanced, by at least one year distance, in the same curriculum. As we will show in this paper, teaching other students and being taught by peers is a useful concept, not only from a practical point of view, but also from the perspective of educational theory. For the sake of clarity and style, we will usually speak of students, but in principle, the mechanisms described can be applied just as well to postgraduate training.

Peer teaching, peer assisted learning, peer tutoring, peer assessment or any other use of students or trainees in the role of teachers is popular in higher education (Topping 1996; Falchikov 2001). After the introduction of structured peer teaching formats in primary and secondary education in the 1960s and 1970s (Devin-Shehan et al. 1976), it became more and more popular in higher education. Goldschmidt & Goldschmidt (1976) claimed that the rapid growth of the numbers of student in higher education in the 1970s as well as new educational insights and economic and political developments served as fertile soil for the rise of peer teaching arrangements in higher education. Times may have changed, but reports of peer teaching in the literature have kept appearing. Many individual papers are descriptive in nature and reviews that summarize these papers base their usually positive reports to a large extent on surveys that investigate satisfaction with the educational format (Goldschmidt & Goldschmidt 1976; Whitman 1988; Topping 1996; Falchikov 2001). The theoretical and empirical underpinning, however, is often limited, if at all included.

Many medical schools now apply peer teaching in one way or another (Moore-West et al. 1990). In doing so, tradition and practical reasons, as opposed to evidence from the literature or

## Practice points

- A small distance between teacher and learner may foster learning because of cognitive congruence.
- Social congruence theory may explain why learners may feel more at ease with a near peer teacher than a senior expert.
- Peer teachers may benefit from teaching, as it may stimulate high level processing of information during the phase of preparation as well as at the delivering of education.
- Role theory and several adjoining theories explain why students in the position of a teacher build self esteem and may benefit on a motivational level.

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considerations from psychological theory appear to guide the decision to employ students as teachers. Practical reasons, local circumstances, financial possibilities and time pressures often force teachers and curriculum designers to choose whatever teaching methods seem available and workable. Students have been used as teachers in medical education for decades or maybe even centuries, without much question about the relative benefit as compared with 'regular' or expert faculty teachers. For example, anatomy has long benefited from students as teaching assistants in dissection classes and these students usually claim that this teaching experience is a valuable preparation for surgical and other careers (Ocel et al. 2003).

Given its growing popularity, we believe that it would be useful to learn how psychology can help us understand the dynamics and effects of peer teaching. In this paper we will synthesize aspects of psychological theory that have been associated with peer teaching in the literature of the past decades.

## Three dimensions to categorize peer teaching in higher education

Peer teaching, the general term we will use throughout this paper, has several forms and numerous terms relating to peer teaching are used in the literature. We believe it is helpful to first classify manifestations that can be subsumed under this broad term. They may be categorized by three dimensions illustrated in Table 1 (Goldschmidt & Goldschmidt 1976, Cornwall 1980, Ten Cate 1986).

### Distance between students teaching and students taught

Teachers and students may be at an equal stage of training (sometimes called same-age, same-level or reciprocal teaching) or they may be distant from each other, e.g. when final year medical students teach first year students, or residents (registrars) teach medical students. When teachers are on a different level than learners (i.e. registrars teaching medical students), this is often called 'cross-age' or 'cross-level teaching'; when the teacher and learner are on the same educational level, but differ by one or more years (i.e. final year medical students teaching first year medical students) we refer to this process as 'near-peer' teaching. In the examples in Table 1 this distance varies from 6 to 7 years in one programme in which 'junior students often teach senior students', implying a *reverse* distance (Gustafsson et al. 2006).

**Table 1.** Dimensions in the practice of peer teaching.

| | Distance between teacher and learner | Group size | Formality |
|---|---|---|---|
| Low | Less than one year | Individual encounters (one or two learners) | Informal setting |
| High | One or more years | Group encounters (three or more learners) | Formal setting |

But even with teaching, in which students take turns in peer tutoring each other, the teachers can develop relatively more expertise in a specific field or topic that can allow them to act as a teacher. This can result from more intensive preparation for a group meeting or lab class (Brueckner & MacPherson 2004; Krych et al. 2005).

### Group size of students taught

A second dimension is the *group size* of students taught. Group sizes include one-to-one peer teaching (often called peer tutoring), peer teaching applied in small group settings, and peer teaching in large group settings. Occasionally students may lecture younger peers on a specific topic, and thus serve a large class (Ten Cate & Heymans 1982). Teaching in different group sizes is likely different, requiring unique sets of knowledge, skills, and attitude (e.g., one-to-one peer tutoring may benefit from counselling skills, whereas adequate group teaching requires the understanding of group dynamics). We made a distinction between one-to-one or one-to-two tutoring as individual encounters, versus one-to-three or more teaching, signifying three as minimum size of a group, as a minimum of three students is needed to establish a group dynamic process.

### Formality of the teaching arrangement

A third dimension is the *formality* of the teaching within the educational program. One extreme of the formality dimension could involve having peers informally working together to prepare for classes or tests, rehearsing with each other outside the school environment, and/or explaining to each other difficult subject matter. The other extreme uses peer teachers as an obligatory part of the educational program. For example, medical students could potentially replace regular teachers in courses such as problem based learning sessions or lab classes. Student-led extra curricular activities, with an educational focus, such as student-led conferences and symposia would be considered to have low level of formality, if considered from a curricular point of view.

### Overview of terminology

The literature has a plethora of terms for peer teaching, as many authors give labels to new methods of teaching. Examples of these with a peer teaching format are Personalized System of Instruction, Keller Plan or Proctoring (Keller 1968), The Jigsaw Method (Aronsons et al. 1978), Education through Student Interaction ETSI (Goldschmidt & Goldschmidt 1976) and Syndicate method (Collier 1966) to name just a few.

Given the multiple terms and manifestations of peer teaching, we suggest the following categorization, derived from the three dimensions mentioned above, and applying the more frequently used terms (Table 2).

In its most simplified form, we suggest to use 'near-peer teaching' when more advanced students teach less advanced ones (Whitman 1988) and 'peer teaching' when students teach

fellow students on the same educational level in the same academic year.

## The psychology of peer teaching

To understand the significance of the psychology behind the effects of peer teaching, it is important to distinguish the different potential manifestations of peer teaching. For example, the 'cognitive congruence' concept serves as an explanation why subject matter may be better understood by learners when medical students teach fellow medical students than when faculty teach medical students. At the same time, role theory predicts an increase in motivation in the student who teaches fellow students. Here, little distance may not necessarily be more effective than a large distance. Indeed, a more formal role as a teacher and teaching before a group may boost the peer teacher's feelings and behaviour best. This high formality level, however, may not lead to better understanding by the receiving peer learners than one-to-one teaching in a more informal setting.

As peer teaching cannot be understood from only one perspective, several theories from psychology have been applied in the literature to explain and predict hypothesised positive and negative effects. In Table 3 we have summarized the theoretical perspectives that will be discussed. These are categorised as (a) the cognitive or metacognitive level of learning or the (b) affective, motivational level of learning, pertaining to (i) students being taught and (ii) students who teach. This leads a two-dimensional framework.

Not all of these theories have been researched rigorously. It should be stressed that to substantiate some of the claims of peer teaching in the literature and from explanatory theory, additional studies should be carried out. It may nevertheless be worthwhile to describe these theories here, to facilitate subsequent studies to confirm or reject the underlying hypotheses, derived from these theories.

## Why would peer teaching be beneficial for the student who receives the teaching?

In many cases, the rationale for using peers as teachers is to solve a growing man power problem in medical education. For example, in anatomy dissection classes where numerous small group teachers are used simultaneously in the lab, many schools employ student teachers. Student teachers have sufficient knowledge, or are able to gain this quickly; they are cheap labour, often have more flexible schedules than faculty and are often enthusiastic. Seldom is the argument made that the student learners gain additional benefit from having non-expert, peer teachers. Nevertheless, some theory suggests potential advantages with being taught by a peer.

### The concept of cognitive congruence

Learning can be viewed as the extension of an existing knowledge base. The organisation of knowledge in long term memory has been described by early cognitive psychologists as a semantic network of concepts and relations between them (cf Lindsay & Norman 1977) and learning as adjustment of the network by accretion (adding information), restructuring (modification of cognitive schemas) and tuning (fine adjustments for adequacy and efficiency). From this view, learning is the adjusting of a prior knowledge base and teaching is helping to do this. Experts have much more elaborated and differently structured semantic networks than novices and can have difficulty understanding students' cognitive problems and needs. Cornwall (1979) postulated that a teacher with a semantic network that more closely resembles that of the learner understands these needs more easily and can offer help more efficiently. Support for this 'cognitive congruence' hypothesis in peer teaching arrangements was provided by Moust & Schmidt (1995) and recently by Lockspeiser et al. (2006). This hypothesis pertains specifically to enhanced information processing by the students being taught. This

**Table 2.** Peer teaching terminology in different arrangements.

| Distance | Group size | Formality | Examples | Terminology, used in the literature |
|---|---|---|---|---|
| low | low | low | Students working together to prepare for a test, rehearsing each other | *Peer assisted learning (PAL); Peer counselling; Cooperative learning* |
| high | low | low | Personal coaching by an experienced senior | *Near-peer tutoring; Near-peer mentoring* |
| high | high | high | Senior medical student rehearsing groups of junior medical students | *Near-peer teaching* |
| high | low | high | Residents as formally scheduled tutors or mentors | *Near-peer tutoring; near-peer mentoring* |
| high | high | High | Teaching assistants in lab classes or skills training; Residents as group teachers | *Near-peer teaching* (within same level of training); *Cross-level teaching* (different level of training) |
| high | high | low | Student-organized extracurricular voluntary group activities | |
| low | high | high | Students taking turns to teach their small group | *Reciprocal teaching; co-teaching* |
| low | low | high | Scheduled dyad tasks within lecture or small group sessions | *Peer assisted learning (PAL); Co-tutoring; Reciprocal tutoring; Teaching dyads; Peer monitoring* |
| low | low | low | Senior students or resident counselling junior students in clinical clerkships | *Student mentoring; Peer modelling; Peer coaching* |

**Table 3.** Classification of theoretical perspectives on peer teaching.

| | Postulated benefit for the student being taught | Postulated benefit for the teaching student |
|---|---|---|
| Cognitive and metacognitive level of learning | *Cognitive congruence* | *Goal-oriented information processing and verbal elaboration* |
| Affective and motivational level of learning | *Social congruence* | *Role theory and adjoining theories* |

assumption is related to a well known concept from educational psychology. Accoring to Vygotsky (1978), learning is optimized if a distance between what is already known and understood and what must still be learned is just enough to stimulate active inquiry by the student, a distance called the 'zone of proximal development', that evokes a constructive cognitive friction, which asks to be resolved (Ten Cate et al. 2004). Near peers may sense this zone of proximal development much more easily than content experts, who may not always understand the cognitive problems student experience when processing new information (Topping 2005).

### The concept of social congruence or role congruence

Students, taught by peers may also be motivated to spend more effort in studying. According to Sarbin (1976), the social congruence aspect of role theory explains how in primary education cross-age tutoring (i.e. higher class children tutor younger ones), can stimulate the younger students. Children, asked to tutor younger kids, cannot use the same reward and punishment options as regulars teachers have at their disposal. They must therefore revert to other interpersonal rewards, such as offering friendship and serving as a role model. This theory may be less appropriate in higher education, but specifically where the choice is between large class lectures or student-led small groups teaching, the latter may indeed lead to a more personal attention and better enculturation and acceptance within the particular school climate. Additionally, one could imagine also that a trusting relationship with a peer who holds no position of authority might facilitate self disclosure of ignorance and cognitive errors, enabling subsequent diagnosis and correction (Topping 2005). Thus, according to role theory, a near-peer may be a better catalyst for learning then a more senior teacher, provided that this near peer has sufficient content expertise on the topic.

Social and motivational aspects also apply to groups. Moust & Schmidt (1995) found student PBL tutors to be more interested in the daily lives, study experiences and personalities of those being taught than regular teachers, at least in the view of the students who were tutored. This was confirmed by the findings of Lockspeiser et al. (2006). Junior students are logically anxious to know what lies ahead and near-peers may serve as valuable role models and help build confidence in their peers: 'just the confidence of knowing that the second-years made it, if *they* know this, *I* can do it too' (Lockspeiser et al. 2006). Students need to have faith in their skill to acquire knowledge (Weiner 1972); near-peers may help to reduce anxietly and to get this faith and thus foster learning.

Also, the 'hidden curriculum', the set of unwritten rules that must be followed to 'survive' the programme, is largely transmitted by older to younger students. Clearly students are already important role models for their younger peers. They can even be of help to attract applicants for medical school in selection procedures (Drouin et al. 2006). This social congruence, or role congruence, has the potential to significantly influence student behaviour.

## Why would peer teaching be beneficial for the student who provides the teaching?

Well known sayings such as Socrates' 'docendo discimus' (we learn by teaching) or 'to teach is to learn twice' allegedly said by the early eighteen century French philosopher Joseph Joubert (Whitman 1988) claim that teaching is an effective way of learning. An often cited, but not well founded hierarchy of teaching methods that leads to difference in recall of received information is the Bales' Learning Pyramid. In this pyramid, listening to lectures would lead to 5% recall, whereas the bottom of the pyramid, teaching others, leads to 80% recall. We were not able to find the studies that have yielded these figures, but the comparison has some face validity, as many teachers confirm that their own teaching makes them understand and remember things much better than listening or reading. In a pre-/post- test randomized study, paediatric residents who were asked to teach 30 minutes gained significantly more knowledge, measured 6 to 8 weeks later (effect size = 0.84), than controls who were asked to listen to a 30 minute lecture on the same topic (Weiss & Needlham 1998). Earlier controlled studies by Dunkin & Hook (1978) reported a similar effect in the field of anatomy teaching. How can we explain this benefit from teaching?

### Goal-oriented information processing and verbal elaboration

Peer teaching, as it is addressed in this paper, is confined to a setting in which one student teaches one or more less advanced fellow students. This teaching includes more than the session together with the students. There is a phase of preparation and a phase of face-to-face teaching; the latter can be further divided into presenting information and interaction with students, both of which involve verbalization.

**Table 4.** Parallels of peer teaching with Maslow's hierarchy.

| Maslow's hierarchy of needs (8 level version) | Explanation | Parallels in (peer) teaching |
|---|---|---|
| 5a. Transcendence | Helping others to self-actualise | Altruistic satisfaction from helping others to become superior doctors |
| 5. Self actualisation | Personal growth, self fulfillment | Satisfaction from one's personal contribution to a significant goal |
| 4b. Aesthetic needs | Beauty, balance, form | Satisfaction from observing a (group) learning processes |
| 4a. Cognitive needs | Knowledge, meaning, self awareness | Satisfaction from having and using relevant knowledge |
| 4. Esteem | Achievement, status, responsibility, reputation | Satisfaction from having a teaching status and responsibility |
| 3. Belonging and love | Family, affection, relationships, work group | Satisfaction from individual peer counselling and being counselled by a peer |
| 2. Safety | Protection, security, order, law, limits, stability | No specific relationship |
| 1. Biology and physiology | Air, food, drink, shelter, warmth, sex, sleep | No specific relationship |



Preparing for teaching calls for a different approach to the study material than studying to take a written examination. Bargh & Shul (1980) showed in an elegant randomized experiment that psychology students who had been asked to study a text for 15 minutes with the task of teaching other students about it, scored higher on an unexpected written test than controls who were asked to study for this test. Scores were higher on recall and recognition questions and fundamental matter as well as details. To understand what happens when preparing for teaching, as compared to preparing for a test, it is helpful to think of the cognitive strategy that students use. Optimizing an anticipated test score means that the student must try to imagine what the teacher is likely to ask; this serves as a goal during reading and memorizing. Conversely, students who prepare for teaching can determine their own goals and priorities, choose how this subject matter should be explained, and anticipate how possible questions should be answered. The difference is that in the case of a test the student has no influence on the memory retrieval context, but in the case of teaching he or she has a large influence on this context. Personal goal setting during learning has been long recognized as being important for the learning effect, e.g., Bruner (1961) theory of discovery learning and by Ausubel (1963) when describing his theory of meaningful versus rote learning. Defining personal learning objectives is also a key element of problem-based learning (Schmidt 1989).

Verbalization and recitation has also long been recognized as important for learning (Dewey 1910). Support for the benefit of verbalization in peer teaching in higher education settings has been demonstrated in experiments by Long (1971), Gaynor & Wolking (1974), Johnson et al. (1976) and Annis (1983). This may apply to both the presentation and interaction phases of teaching (De Grave et al. 1996). Verbal recitation of learned material has shown to be superior in some instances to other applications, such as discussion (Custers & Boshuizen 2002).

In sum, for both the preparation and execution phases of teaching before an audience of peers or near peers, psychologial theory and empirical findings support a clear beneficial effect of the act of teaching on the acquisition of knowledge for the peer teacher.

## Social, emotional and motivational benefits of teaching

Assessment is often said to drive the learning in medical education. As this is self-evident—a test forces student to prepare for it—it may not be the only drive.

Theory shows that human beings have several drives that lead them to act as they do. Maslow (1987) constructed a famous five-layer hierarchy of needs to be fulfilled to generate satisfaction in human beings, ranging from physiological needs, safety needs, love and belonging, to the need for esteem and recognition and self-actualization. Later, cognitive and aesthetic need levels before self-actualization were added to the model and a top level called 'transcendence' (spiritual needs) was added, resulting in an eight layer model. Maslow's model hypothesizes that needs autonomously ask to be fulfilled, once lower layers of needs are sufficiently satisfied. The teaching of others relates to several of these layers. In Table 4, for each of the Maslow layers, a possible effect of teaching is described.

Allen & Feldman (1976) have linked role theory to peer teaching. In accordance with Maslow's model, role theory explains not only how feelings lead to behaviour, but also how behaviour leads to feelings. Self confidence can be fostered by teaching others when persons are placed in a position of authority, e.g. when assuming a teacher role *vis-à-vis* peers. Subsequently, motivation to spend effort to attain this position, and to satisfy Maslow's 'esteem need', may lead to added learning effects through the act of teaching. Other theorists have confirmed the possibility to manipulate self-perception and feelings of self-efficacy through particular roles or functions people execute in relation to others (Festinger et al. 1956; Bem 1972; Bandura 1982). A person, placed in a particular position, tends to adapt his or her self perception in accordance with the position – whether being a policeman, a chairman, a mother, a student, a reverend, a teacher or any other established position (Bem 1972) and may even instantly

change their self perception when moving from one role (giving a key note lecture before a large audience) to another (having your high school son fix your computer problem). Previously held convictions may be adapted because of roles played, to solve uneasy feelings of cognitive dissonance (Festinger et al. 1956). As an illustration of this, think of the typical student *vis-à-vis* expert teachers. This student has learned to behave according to the position a relatively ignorant person and viewes himself or herself accordingly. Once placed in the position of a teacher, the same student my gradually build confidence and appreaciate the own role of an expert person. Cognitive dissonance theory predicts that this student will start to genuinely believe in the own expertise, as an effect of the role played.

Weiner has elaborated how students attribute their successes and failures to causes inside or outside themselves and to stable or unstable factors, often more based on perceptions than on reality (Weiner 1972). Re-attribution training, designed to help abandoning inadequate, often counter-productive attribution styles, may help students foster confidence in their personal strengths; playing the role of a teacher may serve to this purpose. Falchikov (2001) points to possible adverse effects that role theory predicts in peer tutoring. One-to-one peer teaching may boost the teaching student's feelings at the cost of the learning student's ones. However, she also stresses the strengths of peer tutoring and suggests solutions, such as frequent role change, training peer tutors for their role and choosing tasks that do not particularly stress authority differences.

Another, more recent theory—self-determination theory (SDT)—relates to role theory and can explain why intrinsic motivation may benefit from being a teacher. SDT claims that intrinsic motivation is caused by three features: competence, autonomy and relatedness to significant others (Ryan & Deci 2000). Playing the role of a teacher may very well serve to create feelings in these three domains. A student or registrar, placed in the position of a teacher of near- peers, experiences a different relation to them. As said before, acting as a relative expert makes one *feel* like a relative expert. It generates these particular feelings of competence, autonomy and esteem before others, which in turn could motivate the teacher to spend further energy in studying ('success breeds success'). It may also have a direct cognitive benefit. This could explain why verbalization to make things clear to a peer was found to lead to better recall of information than verbalization to a senior experimenter by Durling & Shick (1976).

In sum, several established theories from psychology explain why assuming the role of a teacher may serve to build confidence, motivation and cognitive development. In addition, social psychology theory informs that group dynamics and group expectations have powerful effects on the members of a group and on individual roles of these members. When students in turn are expected to execute teacher tasks, they generally appear to be highly motivated to be prepared to do this, if this group has any importance for them. The same may hold for near peers. The reason why student-teachers often perform well (e.g., Ten Cate 2007) may be attributed to the motivating expectations of significant others. The social pressure of a group expecting a well informed teacher—or peer in a teaching role—serves as a powerful engine to prepare well for this teaching.

## Teaching as part of learning

Much of what happens in education is only partly understood, by both teachers and learners. Why do some forms of teaching evoke enthusiasm, why do other forms not? Education is a dynamic enterprise, and procedures, aimed to optimize teaching sometimes have adverse effects. Teachers and students may basically misunderstand each other, as they view education from different perspectives. Teachers may be disappointed by the unexpected behaviour of students, and students may not understand why education is practised the way it is. So, why not make students think like a teacher? And why not make teachers dig into the psychology of the student and into theories of learning? Habits and tradition, limitations of the environment, practical solutions for managerial problems, availability of faculty with varying interest in education and other practical aspects often determine the educational programme much more than the original educational philosophy or theoretical insights from educational psychology. As teachers, we should not forget to understand the dynamics of education and learning, the ways to motivate students and the tools to facilitate learning. Reflecting on human psychology and listening to what theoreticians have to say who did much of this reflection before us, translating theories of teaching and learning into practice and testing hypotheses to establish the validity of these theories can help us to understand and improve our teaching and the learning of who we serve. As Kurt Lewin said—nothing is as practical as a good theory. We strive to teach medical students to be reflective practitioners, but shouldn't we also learn to be reflective educators and learn from teaching? Students can be teachers, but teachers can learn to be students too.

## Notes on contributors

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