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TUTORAT PAR LES PAIRS : DE (LA) THÉORIE À LA PRATIQUE

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Article abstract

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NOTE FROM THE FIELD / NOTES DU TERRAIN

PEER TUTORING IN THE ELEMENTARY CLASSROOM: PUTTING (A) THEORY INTO PRACTICE

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ABSTRACT. This essay explores how elementary school teachers can support students in becoming effective peer tutors. Drawing on the author's personal experience as an elementary educator and researcher, it discusses how cognitive load theory can be used to generate a framework to support practicing teachers in implementing peer tutoring in their own classrooms. The framework presented is particularly relevant to well-structured learning domains, such as mathematics.

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RÉSUMÉ. Cet essai s'intéresse aux moyens que possèdent les enseignants du primaire pour aider leurs élèves à devenir des tuteurs efficaces pour leurs pairs. En se basant sur son expérience personnelle comme enseignant et chercheur au primaire, l'auteur présente la manière dont la théorie de la charge cognitive peut être utilisée en classe pour créer un cadre soutenant les enseignants dans l'implémentation du tutorat par les pairs dans leur classe respective. Le cadre présenté se révèle particulièrement pertinent pour les domaines d'apprentissage très structurés, comme les mathématiques.

Nearly a decade ago, during my first ever teaching round, a Grade 2 class I was observing was learning about the associative property of addition and the importance of looking for patterns when adding numbers. After a "mini-lesson" on the floor, the teacher had set some independent problems for students to work on (problems like 99 + 99 + 1 + 1 = ?). Fred, who was normally strong in mathematics, remained somewhat confused. Even though he had a good sense of numbers, he had always assumed that numbers had to be added left to right, just like letters on a page had to be read left to right. During the mini-lesson, he was also a bit distracted by Charlotte and her new Transformer toy, which she had smuggled onto the carpet. He had just started adding numbers left to right, as he always did, however was then told by Thomas that "we are not supposed to add that way today." Fred tried to copy Thomas, but Thomas became annoyed and moved his hand over his work. He kept giving Fred dirty looks, saying with his eyes, "don't you dare try to copy me." Charlotte was again playing with her Transformer toy under the table and Fred was becoming increasingly distracted. He had his hand half up, unsure whether he really wanted help or just to sit this one out. Alice, an extremely bright, articulate, and socially-aware student, had already finished most of her work, and noticed that a few other students seemed unsure how to proceed. The teacher was very busy with a small group of students working on the floor. Alice saw that Fred's hand was up and walked over to him. The teacher saw Alice out of her seat and asked, "What are you doing?" Alice replied, "Fred needs help." The teacher stated: "If Fred or anyone else needs help, they can come to me on the floor. You need to stay in your seat."

Alice complied, Fred put his hand down and stayed seated, while a couple of other students took the opportunity to wander to the floor to get some help. Five minutes later the teacher's group on the floor had grown to 15 students — she certainly had their hands full! Alice had now finished the extension problem and was drawing a picture. Fred had his head down in his seat, keeping a low profile, now completely enthralled by Charlotte's toy. From my privileged position as an observer, the way this scenario unfolded seemed like a missed opportunity. Reflecting on this experience, it occurred to me that there was almost certainly untapped educational potential in peer-to-peer learning.

I became fascinated with the idea of peer tutoring. Intuitively, I felt it would benefit all students. Tutees would be given an opportunity to tune into a different voice, possibly a voice more sensitive to their language and more familiar with their world view. Moreover, given that a classroom is typically comprised of 25 students and one teacher, peer tutoring could reduce the time a student waited to receive assistance. Tutors would have an opportunity to deepen their understanding of concepts, to reflect on how they knew what they knew and enhance their metacognitive functioning. However, in my first years in the classroom, beyond the apparently ubiquitous advice of "good tutors hint, but don't tell," which appeared on an anchor chart in the room of one of the more experienced teachers, I struggled to reconcile my intuition with my practice.

As a teacher, I felt that the concept of peer tutoring lacked a clear organizing framework that could guide its practical implementation in the classroom. Moreover, as I have gained additional experience as a researcher, I realized that such an organizing framework would also require a sound theoretical underpinning, supported by extensive empirical evidence. The remainder of this essay describes how cognitive load theory can be used to conceptualize and develop a practically-oriented, theoretically-sound organizing framework to support peer tutoring in classrooms.

WHAT IS COGNITIVE LOAD THEORY?

Cognitive load theory is a view of human cognitive architecture premised on the idea that our working memory is limited in capacity when dealing with novel information, and therefore is sensitive to cognitive load (Sweller, 2010). There are three types of cognitive load relevant to cognitive load theory: Intrinsic cognitive load, germane cognitive load, and extraneous cognitive load.

Intrinsic cognitive refers to task complexity. It captures the relationship between what the task requires of the learner and the learner's level of expertise (Schnotz & Kurschner, 2007). By contrast, extraneous cognitive load concerns wasted mental effort generated by poor instructional design. Finally, germane cognitive load refers to the "working memory resources that the learner devotes to dealing with the intrinsic cognitive load associated with the information" (Sweller, 2010, p. 126). Cognitive load theory implies that teachers should develop instructional tasks and approaches to instruction that *minimize extraneous cognitive load, maximize germane cognitive load and optimize intrinsic cognitive load.* In other words, students should be able to direct as much of their mental resources as possible towards learning the material, and the complexity of the material to be learnt should be "just right" for a given learner. I think almost all teachers would tend to agree with this highly-intuitive maxim.

A FRAMEWORK FOR PEER TUTORING

How might cognitive load theory inform a classroom teacher about how to structure peer tutoring? I believe it can be used to generate a pragmatic, at times counter-intuitive, instructional framework that can be used in elementary school classrooms. These seven steps, and their underpinnings in cognitive load theory, are presented below.

1. Move to a quiet place in the room. This is perhaps the most common-sense recommendation arising from cognitive load theory. As noted above, our working memory capacity is limited. If extraneous cognitive load increases, this necessarily leaves fewer mental resources dedicated to schema acquisition and automation; or, what has been termed in the literature germane cognitive load (Sweller, 2010). Consequently, any distraction students experience through direct or indirect involvement in other classroom interactions that are not connected to the learning task will increase extraneous cognitive load. Moving to a quiet place in the room when undertaking peer tutoring reduces distraction and consequently extraneous cognitive load.

2. Work together in the tutee's book. Expecting a student to copy down a problem from the board, study a peer's book and complete a problem in his or her own book requires the tutee to integrate three physically-separate sources of information. This has been termed the split-attention effect (Sweller, 2010). In order to avoid the peer tutoring experience inadvertently increasing extraneous cognitive load through the split-attention effect, it is suggested that the tutor work in the same book as the tutee.

3. Don't just hint, tell! In the first instance, when working with another student, it is suggested that the tutor "tell" the other student how to solve the problem, rather than simply "hint." This particular implication of applying cognitive load theory in a peer tutoring context was certainly counter-intuitive to me when I first encountered it, and requires some explanation. One of the earliest consistent findings of cognitive load theory was that novice learners learnt more when problems to solve were interspersed with worked examples (Bokosmaty, Sweller & Kalyuga, 2015). It was subsequently demonstrated that the mechanism underpinning this finding is that studying worked examples reduces the (extraneous) cognitive load of the learning activity. Specifically, students find learning less cognitively taxing if they are explicitly shown all the steps involved in solving a problem *before* they are expected to solve such problems independently. This is particularly the case if they are inexperienced in solving problems of this type (Renkl & Atkinson, 2003). In a peer tutoring context, this most likely means the tutor showing the tutee how they solved a particular problem, through some combination of talking through the problem-solving process and/or or writing down the steps involved (see step 4 below).

4. Show and tell! Working memory contains both an auditory component and a visual component. Although these two components are limited in capacity, they are believed to operate somewhat independently from one another. Indeed, it has been demonstrated that when multiple sources of information need to be processed simultaneously in order to be understood, presenting complementary information in both auditory and visual form can *increase* working memory capacity (Tindall-Ford, Chandler, & Sweller, 1997). This has been described as the modality effect (Sweller, 2010). In our peer tutoring context, this would suggest that the tutor should present their workings visually *and* talk through their thinking processes.

Unfortunately, this issue is further complicated by another aspect of cognitive load theory: the redundancy effect. The redundancy effect essentially describes the results when information presented through the auditory and visual modes is repetitive, rather than complementary (Sweller, 2010). In this instance, the cognitive load dedicated to integrating the two modes of information does not add to learning, and hence is extraneous (Ginns, 2005). This is clearly a complex issue for young tutors to navigate! How can they be expected to know if their audio commentary of their work is enhancing working memory capacity or simply redundant? One way around this is to encourage tutors to use their words to describe *why they did what they did* and to use symbols, pictures, and other visual representations to *show what they did*. In this way, the tutor maximizes the possibility that information from the two sources will result in a positive gestalt, where the resultant integrated understanding is more than its component parts.

5. Hint, but don't tell. Renkl and Atkinson (2003) demonstrated that as a learner's experience with a particular problem type increased, he or she tends to progress from worked examples, to completion problems, and finally to fully intact problems. They termed this the guidance-fading effect. Given that tackling a completion problem can be viewed as having a lower cognitive load than a fully intact problem, it would appear to be the appropriate next step in the process we are describing. However, what is a completion problem? A completion problem can be compared to a partially-completed worked example, where some of the important information is missing and must be filled in by the learner.

In a peer tutoring context, the "hint, but don't tell" approach is tantamount to creating a completion problem. Through providing hints, the tutor is reconstructing the problem for the tutee. One approach would involve the tutor making explicit the instructional steps they themselves would go through if solving the problem, and expecting the tutee to follow these steps. Depending on the structure of the problem (and the expertise of the tutee), providing guidance around the first step may be sufficient for the tutee to complete the rest of the problem independently. In other instances, the tutor may need to guide the tutee through all the steps involved and perhaps even assist the tutee with the execution of the steps (essentially returning to a worked example scenario, where the tutee is "not just hinting, but telling").

6. Have a go! At this stage, the tutee is likely to be ready to attempt to solve the problem independently. Ideally, the tutor should remain in physical proximity to the tutee, however may return to his or her own work to allow the tutee some time to engage with the problem.

7. The tutee teaches the tutor. Some groups of researchers within cognitive load theory have also focused on instructional techniques for increasing schema acquisition and automation, that is, strategies for increasing germane cognitive load. One such means is to have students self-explain a new concept or process (Wittwer & Renkl, 2010). This self-explanation effect has been empirically established to increase learning (Sweller, 2010). In a peer tutoring context, a logical extension to self-explanation would be for the tutor and the tutee to switch roles, and for the tutee to explain the process to the tutor. Consequently, after the tutee has spent some time working independently on a problem (Step 6), it is suggested that the tutor and tutee should come back together, with the tutee now adopting the role of teacher rather than student.

OBSERVATIONS, PROVISOS, AND CONCLUSIONS

Peer tutoring will be most effective when the student being tutored has the requisite knowledge, skills, and understandings for learning the new concept. Consequently, it is appropriate for either member of the tutoring dyad to communicate to the teacher when they feel they cannot make progress. The teacher may then decide to redirect the tutor back to Steps 3 and 4, and encourage him or her to generate some additional worked examples for the tutee to study, or may suggest an end to the tutoring session. In some instances, it may be appropriate for another tutor to "have a go" at teaching the student. Usually, however, the teacher will take control and either attempt to re-explain the concept to the student or provide the student with an alternative activity that attempts to consolidate the requisite prior learning.

It is essential that the peer tutoring interactions taking place in the classroom are overviewed by teachers, and that teachers regularly listen in to tutoring sessions, providing tutors with feedback and support. Obviously teachers also need to be sensitive to balancing opportunities for peer tuition with the chance for capable students to engage in more challenging work. Having said this, in my experience observing young tutors, being in the tutor role has a number of benefits for students, including deepening their understanding of concepts, strengthening their capacity to reason and explain their thinking to others, and improving social skills.

I have implemented the seven-step peer tutoring instructional framework in my own classroom during mathematics instruction with students as young as seven and eight years of age, covering topics such as addition strategies, place value, and multiplication. For each of these topics, peer tutoring was particularly relevant because there was a clear group of students who understood the core idea (e.g., they understood that numbers can be partitioned into parts to make addition easier), and a group of students who seemed to have the relevant prior knowledge but for whom these new important ideas remained elusive.

In my classroom, the framework is displayed as an anchor chart for students to access, and tutors and tutees are generally expected to initiate tuition and follow the steps outlined, independently of teacher guidance (see Figure 1). To facilitate this, I initially spent several sessions modelling and explaining the framework during our mathematics lessons. Specifically, I would place myself in the role of "tutor" and move through the seven steps with a nominated student who would play the role of "tutee." During subsequent sessions, I allowed several students to play the role of tutor and encouraged other members of the class to monitor whether the tutor and tutee were careful to follow the seven steps outlined in the framework.

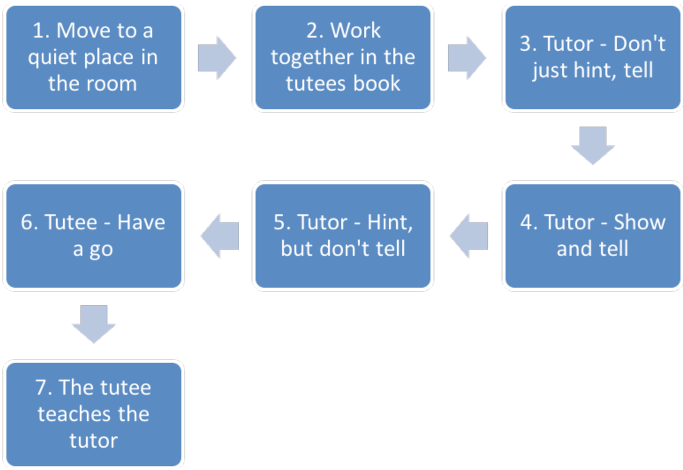

FIGURE 1. *Summary of the peer tutoring framework*

A peer tutoring framework built around cognitive load theory has significant potential for improving the quality of peer tutoring across a variety of curriculum areas, particularly in highly structured domains such as mathematics. It provides an example of how theoretical and empirical developments in educational psychology have the potential to directly inform classroom practice, particularly when such developments are reconstructed through the lens of a practicing teacher. I would encourage other interested teachers and teacher-educators to experiment with the framework outlined in this article in their own classroom and provide feedback about their own experiences.

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