

2007

The development of pre-service teachers' conceptual understanding of scaffolding numeracy

I. Verenikina

University of Wollongong, irina@uow.edu.au

M. Chinnappan

University of Wollongong, mohan@uow.edu.au

Andrew Foxwell

University of Wollongong

Follow this and additional works at: <https://ro.uow.edu.au/edupapers>



Part of the [Education Commons](#)

Recommended Citation

Verenikina, I.; Chinnappan, M.; and Foxwell, Andrew: The development of pre-service teachers' conceptual understanding of scaffolding numeracy 2007.

<https://ro.uow.edu.au/edupapers/1136>

The Development of Pre-service Teachers' Conceptual Understanding of Scaffolding Numeracy

Irina Verenikina, Mohan Chinnappan and Andrew Foxwell,
Faculty of Education, University of Wollongong
irina@uow.edu.au

Abstract

Becoming a quality teacher involves the acquisition of subject matter knowledge as well as the development of appropriate pedagogical teaching skills. The latter includes knowledge and understanding of scaffolding strategies based in an increasingly popular socio-cultural theory of Lev Vygotsky. Recent research in teaching mathematics identified a wide variety of scaffolding techniques that can be used in the classroom to improve primary school students' numeracy. However, there is a highly diverse interpretation of scaffolding in the literature which creates difficulties for pre-service teachers when they attempt to make sense of this popular teaching technique and apply it to their teaching. It is the position of this paper that teaching scaffolding in close connection to its theoretical basics will allow pre-service teachers better anchor their repertoire of scaffolding numeracy techniques and will promote its proficient and flexible use in the classroom.

This paper describes a combined effort of lecturers in Educational Psychology and Mathematics in teaching scaffolding numeracy. Examples of theoretically grounded case based scaffolding teaching strategies for pre-service teachers are presented.

Introduction

The current government request for improving the quality of teaching (NSWIT, 2006) has brought into focus issues concerning the role of teacher educators to ensure that pre-service teachers receive appropriate training. Becoming a quality teacher involves the acquisition of subject matter knowledge and the development of pedagogically sound teaching techniques that make this knowledge available to children in the classroom. One such technique is captured by the metaphor of scaffolding and is widely used to provide support and guidance to children in a constructivist learning environment. It is based on an increasingly popular socio-cultural theory of teaching and learning that was originated by Lev Vygotsky (1978) and further developed by numerous contemporary theorists (Daniels, 2001).

Recent research in teaching mathematics has identified a wide variety of scaffolding techniques that can be used in the classroom to improve primary school students' numeracy (DEST, 2004; Anghileri, 2006; Morrone et al., 2004; O'Toole & Plummer, 2004).

While the metaphor of scaffolding is being widely used and well recognised in current educational research there is a concern that it has become a generic umbrella term for any kind of teacher support (Jacobs, 2001) which is often no different to a traditional approach of direct instruction. There is also evidence that scaffolding can hinder rather than assist children's learning if not used with care (Stone, 1998; Tudge, 1990, in Moll, 1990). Such an uncertain and sometimes exceedingly diverse interpretation of scaffolding creates difficulties for pre-service teachers when they try to make sense of this popular teaching technique and to apply it to their teaching.

The results of our study (Verenikina, 2004; Verenikina & Chinnappan, 2006) indicate that pre-service teachers see the scaffolding metaphor as a useful concept that allows them to move away from the direct instruction of a traditional classroom and provide a richer and more sophisticated educational tool for the learner. However, while there was evidence of understanding some basic (and peripheral) techniques of scaffolding such as breaking the tasks into smaller pieces, modelling and demonstration, the more important levels of scaffolding did not feature strongly in students'

responses (Verenikina & Chinnappan, 2006). As the concept of scaffolding is complex and diverse, it is anticipated that embedding their practice of scaffolding in its theoretical basics might allow pre-service teachers to anchor their repertoire of scaffolding numeracy techniques. This approach is expected to promote its proficient and flexible use in the classroom.

To successfully teach in an ever-changing school environment, teachers need to be able to adjust their knowledge and skill to a particular classroom situation and tailor to the needs of particular children. This means that teachers have to be able to reflect upon, and think about, their teaching practices in a critical and creative manner. A conceptual understanding of the theoretical framework that supports their pedagogical practices is essential for the development of such ability. It will enable them to better understand specific lesson goals and conditions in the use of scaffolding in particular situations (Sullivan et al., 2006).

Further research needs to explore students' understanding of the use of specific techniques of scaffolding in authentic activities. Designing such activities requires expertise in both the theoretical perspective of teaching and learning, and the teaching of specific content such as mathematics. The effort of lecturers in Educational psychology and Mathematics courses has been combined in the teaching of scaffolding numeracy techniques in conjunction with its theoretical basis, the Zone of Proximal Development (Vygotsky, 1978). Explicit links and connections to the theoretical principles of scaffolding allow pre-service teachers to anchor their repertoire of scaffolding techniques provided by recent research.

The study

The aim of this study is to find a point of confluence between theory and practice that would assist teacher educators develop strategies to support pre-service teachers become competent in fostering the growth of high levels of numeracy among young children. The following questions were explored: What are the ways that pre-service teachers can form a critical and creative view of scaffolding? What is the role of theoretical conceptualisation in this process? How does the conceptual understanding of scaffolding inform teaching numeracy in the classroom? To answer these questions the research has been designed around the three consequent stages:

- Creating and refining teaching materials that allow pre-service teachers to master a range of scaffolding numeracy techniques in a systematic and conceptualised manner;
- Application of the developed materials to teaching scaffolding in general, and scaffolding numeracy in particular, in a third year foundation subject;
- Evaluation of the effects of such teaching on pre-service teachers' understanding of scaffolding and its classroom use.

This paper reports on the first two stages of the research. In stage one the range of scaffolding numeracy techniques described in current literature were identified and analyzed in accord with the criteria of teaching in the Zone of Proximal Development. In addition, the cases of authentic situations of scaffolding numeracy in the classroom were collected. In stage two, the identified scaffolding techniques, the theoretical criteria and the authentic cases were put together to create teaching materials for university pre-service teacher education. These materials were then applied to teaching scaffolding as part of learning the utility of the theory of Lev Vygotsky in the third year educational psychology subject; scaffolding numeracy was presented to pre-service teachers to illustrate the educational implications of the theory and this move formed the basis for a scaffolding case study assignment in the subject.

Scaffolding techniques

Current educational literature provides a wide variety of studies that deal with scaffolding in the classroom. A range of scaffolding techniques presented in the literature were analyzed and

summarized for the purpose of this study. The scaffolding techniques were grouped to form a list of ten major scaffolding strategies consistent with the teaching in the Zone of Proximal Development. The list was presented to the students as a resource for their case study assignment. Table 1 presents a short version of this list.

Table 1. Scaffolding strategies and techniques.

Scaffolding strategy	Descriptions of the specific techniques for the strategy
1. Encourage and promote self-regulation and metacognition	<ul style="list-style-type: none"> • Provide choices (Jacobs, 2001); let students take decisions about their own method of problem solving (Roehler & Cantlon, 1996) • Provide students with the opportunities to practice the skills in different contexts - this might help students to become less dependent on the teacher's support (Hogan & Pressley, 1997, cited in Larkin, 2001) • Encourage the students using scaffolding structures till they become automatic, enabling independent activity completion (Michell & Sharpe, 2000) • Make the child aware of the process which led to the discovery (Coltman, Petyaeva & Anghileri, 2002); explain and reinforce problem solving processes (Nunokawa, 2005); suggest different strategies (Elliot, 1993) • Stress the importance of student talk in fostering metacognitive learning (Mariage et al., 2000); engage children in talking about their problem solving strategies (Elliot, 1993)
2. Motivation, engagement and active involvement	<ul style="list-style-type: none"> • Scaffolding can increase intrinsic motivation by reducing errors and maximising success (Beale, 2005) • Planned lessons need to be motivating and allow students to be actively involved (Madsen & Gudmundsdottir, 2000) • Motivate students towards establishing a shared goal is to provide a delicate balance between allowing the student to lead and following the traditional path of teacher-directed instruction (cited in Larkin, 2001) • Take into account the unique interests, styles and motivations and capabilities of individuals (McLoughlin & Marshall, 2000)
3. Provide constant constructive feedback	<ul style="list-style-type: none"> • Provide constant constructive feedback as part of learning processes. This might promote generality of learning by the introduction of more natural contexts for maintaining the learned behaviour (Beale, 2005) • Students need to be supported and challenged by regular prompts and constructive feedback. Regular quizzes and self tests allow students to check their own progress and predict difficulties and therefore become more independent in assessment (McLoughlin & Marshall, 2000)
4. Building positive, friendly and trusting relationship with students	<ul style="list-style-type: none"> • Use different configurations of interactive possibilities (Dufficy, 2001) • Create an environment where teacher-student relationship are trusting (Rasmussen, 2001), open, friendly, socially based and not always related to classroom learning (Kong, 2002) • Teachers are not only responsible for helping to build understanding of the content, but also for establishing and nurturing social relationships (Mariage et al., 2000) and providing warmth and responsiveness (Seng, 1997) • Make students feeling comfortable in expressing their thoughts in an accepting environment (Roehler & Canton, 1996)

<p>5. Adjustment of support levels; structure tasks in step-by-step portions</p>	<ul style="list-style-type: none"> • Concept of the ZPD, the level of difficulty posed by the task must be beyond the ability of the participants to accomplish independently, but not beyond the ability to accomplish with assistance (Michell & Sharpe, 2005) • Scaffolding can be adjusted to suit the needs of individual students through student's initial reaction and completion of new tasks (Mariage et al., 2000) • Questions should be developed to address the different types of abilities in the classroom (Brown, 2000) • Breaking down a problem into smaller (more achievable) portions will enable proficient learners to improve their practice and will aid not so proficient learners in the initial stages of problem solving (Mousley, 2001)
<p>6. Usage of open-ended questioning and questions which encourage experimenting</p>	<ul style="list-style-type: none"> • Adjust the level of support on a moment-to-moment basis through effective questioning (Mariage et al, 2000) • Open-ended questions may lead to a broad range of responses that allow joint exploration for an answer (Dufficy, 2001) • An easy way to scaffold student learning is to engage in conversations with them using questioning to further the conversation (Roehler & Cantlon, 1996) • Use questions which encourage experimenting (Wood, 2005)
<p>7. Group work guided by teacher</p>	<ul style="list-style-type: none"> • Have small conversations with groups of students during activities, providing simple clues and making immediate positive feedback (Coltman et al, 2002) • Divide the class into small groups when introducing new information. Students will be working within their ZPD and will be able to scaffold each other's learning (Cresswell, Underwood, Withers & Adams, 2002) • Provide opportunities for students to scaffold each other's learning as part of a learning community. (Kong, 2002) • Collaborating, acting as an accomplice, co-learner/problemsolver, co-conspirator, negotiating (DEST, 2004) • Conferences orchestrated by the teacher can play a crucial role in supporting and challenging student's thinking and provided a context for establishing common knowledge (O'Toole & Plummer, 2004, p. 40) • Joint problem solving involves engaging the child in an interesting and culturally meaningful, collaborative problem solving activity (Seng, 1997)
<p>8. Control student frustration through support/ altering activities</p>	<ul style="list-style-type: none"> • Reduce frustration and decrease risk taking in problem solving, eg by modelling and demonstration (Elliot, 1993) • Create a safe environment in which students are free to try alternatives without being penalised (Larkin, 2001) • A complex problem may cause frustration. Provide open-ended tasks that ask students to explore an issue and/or form an opinion (Nir-Gal & Klein, 2004)
<p>9. Use student's prior knowledge in teaching</p>	<ul style="list-style-type: none"> • Ask questions which establish links with prior knowledge, eg Where have you seen this before? What does it sound like? (Brown, 2000) • Provide opportunities to reflect on what the students know and how this knowledge can be expanded (Nir-Gal & Klein, 2004) • Help students relate new information to prior knowledge (Kong, 2002) • Remind about the strategies that were successful before (Larkin, 2001) • Excavating, drawing out, digging, uncovering what is known, making it transparent (DEST, 2004)

<p>10. Help students reshape their responses</p>	<ul style="list-style-type: none"> • The scaffolding procedure gradually changes the response requirement, from an easy (or more likely) responses, through intermediate steps, until the desired response is attained (Beale, 2005; DEST, 2004) • Refine students' broad responses through open-ended questioning, verbal cues and prompts (Mariage et al., 2000) • Noticing, highlighting, drawing attention to, valuing, pointing to: teacher draws students attention to particular feature without telling students what to see/notice (ie, by careful questioning, rephrasing or gestures), encourages students to question their sensory experience (DEST, 2004)
--------------------------------------------------	----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------

Theoretical underpinnings

Vygotskian socio-cultural theory, and the concept of the Zone of Proximal Development (ZPD) in particular (Vygotsky, 1978), is commonly regarded as the theoretical underpinning of scaffolding practices (Berk, 2006; Daniels, 2001; Wells, 1999; Krause et al, 2005).

Vygotsky recognised that the distance between doing something independently and doing it with the help of another person, indicated stages of development, which do not necessarily coincide in all people. In this way he regarded an instructor's "teaching of a student not just as a source of information to be assimilated but as a lever with which the student's thought, with its structural characteristics, is shifted from level to level". (Yaroshevsky, 1989, p.283). Viewing the child as an active participant in their own learning is at the heart of the notion of ZPD. "Within the ZPD the child is not a mere passive recipient of the adult teaching, nor is the adult simply a model of expert, successful behaviour. Instead, the adult-child dyad engages in joint problem-solving activity, where both share knowledge and responsibility for the task" (Wells, 1999, p.140).

Vygotsky (1978) stated that consciousness is constructed through a subject's interactions with the world. Development cannot be separated from its social and cultural context. This led to the idea that we can only understand mental processes if we understand the social interaction and tools and signs that mediate them. Vygotsky emphasised that social interactions are crucial for development from the very beginnings of a child's life. He asserted that any higher mental function necessarily goes through an external social stage in its development before becoming an internal, truly mental function. Thus, the function is initially social and the process through which it becomes an internal function is known as internalisation.

The role of social mediation in human activity has been strongly emphasised by Vygotskian theorists. The child's activity becomes self-regulated when "external behaviours that were defined in part by the culture and internalised by the child can now function as mental tools for her (Dixon-Krauss, 1996, p. 10). In order to become self-regulated, self-motivated learners children have to develop interest and motivation to learn, which according to Hedegaard (2002) "emanates from the social part of the child's life. The intentional interaction with adults and their friends can thus be used as a spontaneous factor for creating motivation" (p.67). Central to the concept of mediation is intersubjectivity which is described by Wertsch (1998) as the establishment of shared understandings between the child and the adult. Intersubjectivity is an essential step in the process of internalisation as the adult gradually removes the assistance and transfers responsibility to the child.

According to Vygotsky, the most important part of children's psychological development is acquisition of the culture to which they belong. Acquisition of mental tools plays a crucial role in the development of children's minds. "The role of the teacher is to "arm children" with these tools...It involves enabling the child to use tools independently and creatively." (Bodrova & Leong, 1996, p.3). Children acquire cultural tools in social interactions with more experienced members of

the society. Moving from shared possession of tools (interpersonal) to individual possession (intrapersonal) is associated with gaining independence and a shift in the development of the child.

Thus, teaching in the ZPD is characterised by such concepts as cultural and social mediation of learning, intersubjectivity, internalisation and the active position of the child. It also includes the means by which the educator meets the level of the child's understanding and leads the child to a higher, culturally mediated level of development. This connects to the tool mediation, that is, to a consideration of what mental tools have been provided for the child to use in their independent performance as well as the conditions that have been created for the tools to be internalised. In other words, what techniques have been used to ensure the transformation of assisted performance into independent performance.

The above core concepts are taught to pre-service teachers in educational psychology subjects in primary and early childhood teacher education programs (Vialle, Lysaght, & Verenikina, 2005). It is argued that understanding the theoretical underpinnings of the metaphor of scaffolding will assist pre-service teachers make sense of the variety of scaffolding techniques and taking appropriate decisions about their classroom application. To assist the students in doing so, explicit connections between the scaffolding techniques (presented in Table 1) and the principles of teaching in the ZPD have been made for the students and summarised in Table 2.

Table 2. Scaffolding strategies and teaching in the Zone of Proximal Development

Scaffolding strategy	Principles of teaching in the ZPD
1. Encourage and promote self-regulation and metacognition	Providing tools for transferring assisted performance into independent performance
2. Motivation, engagement and active involvement	Support student's agency
3. Provide constant constructive feedback	Support student's agency (motivating, engagement)
4. Building positive, friendly and trusting relationship with students	Get to the child's level; create conditions for intersubjectivity
5. Adjustment of support levels; structure tasks in step-by-step portions	Keep the help minimal, to support the child's agency (assisted performance)
6. Usage of open-ended questioning and questions which encourage experimenting	Provide indirect support to keep the child actively engaged; provide challenging tasks to move the child through the ZPD
7. Group work guided by teacher	Create the zone of proximal development
8. Control student frustration through support/ altering activities	Not too difficult tasks
9. Use student's prior knowledge in teaching	Start working at children's level and lead them to higher level of performance and understanding
10. Help students reshape their responses	Start with children's response and lead them to higher level of understanding

Case study approach

To create a constructivist environment for the pre-service teachers for developing their understanding of the scaffolding techniques and the ways that they can be used in the classroom, the method of case studies was utilized.

Case study approach has proved to be effective in teacher education in a variety of ways. The use of

case studies is consistent with constructivist and Vygotskian views of learning as it supports students' active engagement in mastering professional skills (Ewing, Smith & Horsley, 2003). It increases the participants' knowledge about problems of practice and motivate them to think in greater depth about efficient teaching strategies (Manouchehri & Enderson, 2003). Carefully designed case studies bring classroom complexity to university classes (Floyd. & Bodur, 2005) thus enabling authentic learning that reflects the way the knowledge will be used in real life (Herrington and Oliver, 1995). In addition, case-based teaching has been shown as an effective strategy for promoting connections between theoretical and applied knowledge especially when the students are encouraged "to think of multiple, conceptual explanations for problem situations depicted in each case" (Mayo, 2004, p.144). It provides participants "with a lens through which they could view classroom events and interpret them" (Manouchehri & Enderson, 2003, p. 127).

In order to provide prospective teachers with authentic learning tasks for studying scaffolding, a number of detailed cases of using the scaffolding techniques in teaching mathematics in a primary classroom were created. Most of the cases were designed on the basis of the authors' practical classroom experiences and some cases were adapted from the literature (eg O'Toole & Plummer, 2004; DEST, 2004).

All the cases portrayed the characters of a teacher, a student teacher (a third year University primary program student, undertaking professional practicum in the school) and a school student or a group of school students, experiencing difficulties in mastering a particular mathematical content. Each case was provided with specific instructions asking the pre-service teachers to identify the scaffolding techniques (Table 1) and discuss their conceptual connections to the theory of Vygotsky (Table 2). An example of such case (based on the authors' teaching experience) is presented in Table 3 below.

Table 3. A case study example

Case Study 3: David and Chris

David is a teacher in a primary classroom.

Chris is David's current student teacher (3rd year Primary University student)

David has 25 years of teaching experience, but in this school he has been working for about 4 years and currently teaches a Year 6 class.

Chris has taught one lesson on area so far. On reflection of the first lesson Chris discovered that students had little knowledge about how to find the area of 2D shapes and rectangles in particular. There were some students in the class who are still confused between perimeter and area. This lesson Chris decided to take a different approach. He guided students through two examples on the board first and then followed that up with an activity. Chris informed students that those who needed further support could either do the activity if they understood the previous lesson, or participate in an extension of work from the previous lesson. About half of the class selected each option.

ST: From our lesson yesterday, what can we remember about area?*

S1: You do something with two sides of the numbers

ST: Ok, but what specifically do we do with those numbers?

S2: We plus them together

ST: Do we all agree with S2

Ss: No...no!

ST: S3, what do you think then?

S3: You times them?

ST: Do we all agree?

Ss: Yes!

ST: OK, let me draw this rectangle here and we'll give the top and the bottom sides 17cm and the sides 8cm.

Now tell me what to do first

S4: You add the two 17's then the two 8's

ST: What do we think about that?

S6: Sighs (This is too hard)

ST: Well, let us do this first and by then you might change your opinion
 S5: I think we should times 17 by 8
 ST: Why do you think that?
 (hands go up)
 ST: S2 why?
 S2: Isn't area base times height
 ST: You remembered!
 ST: Great job. Let's do it. First let me write up the algorithm: 17 over 8. Let's go! 8 times 7
 Ss: (56)
 ST: I'll put down the 5 and carry the six
 S7: Wait a minute. You are doing it wrong
 ST: Really! Tell me what I'm doing wrong then
 S7: You put the 6 in the wrong place. The 6 goes under the 8
 ST: Oh. That's right.
 ST: 8 times 1 plus 5
 Ss: (13)
 ST: S3 what is the answer
 S3: 136cm
 ST: You see how easy that was? Look at what we did together. Do you think you could do this on your own?
 Ss: (Yes)
 ST: Great. Now before we go back to our tables is there anything we are forgetting in this answer?
 (puzzled looks)
 S2: Umm...
 S5: I know! It's squared. It's 136cm squared.
 ST: Great job!

*ST – student teacher, Chris; Ss, S1, S2 etc. – School students

Guidelines for the Case Study

- Identify two or three scaffolding strategies that Chris used in his work with the students
- Explain the student teacher's use of these scaffolding strategies during this lesson.
- Discuss the theoretical underpinnings of the scaffolding strategies that you have identified.
- Evaluate the way that Chris provided the students with a choice during this lesson. Was it an effective strategy? Why?

To complete the assessment task, the students were asked to choose one case study and discuss using the guidelines and the scaffolding resources (as summarised in Tables 1 and 2).

Areas and perimeters of 2-D shapes are related but different aspects of conceptual understanding of space. There are a number of ways of finding areas and perimeters. While these approaches can be taught it is pedagogically much more useful if students can be scaffolded to discover these. The scaffolding approach takes on a crucial role if the aim of the lesson was for students to discover the relationship between area and perimeter. On the evidence presented in Table 3, it would seem that neither David nor Chris really showed an appreciation of the connections (content aspect of their knowledge). The limited understanding of relational understanding seemed to have hampered their use of an appropriate scaffolding strategy to assist the learner.

Future study

In order to evaluate the effect of the case based teaching on the pre-service teachers' understanding of scaffolding and its classroom use, a variety of methods will be used. A survey will be conducted with all the students enrolled in the subject (approximately two hundred students). The students' written work for their assignments will be analysed. Additionally, a small group of five to six students will be followed up in their classroom practicum to explore the ways that the understanding of scaffolding techniques can be better applied to planning and implementation of mathematics lessons in primary school. The research will be conducted in close collaborations with

the students. Discussions, semi-structured interviews and classroom observations will be used to collect the data.

References

- Anghileri, J. (2006). Scaffolding Practices that enhance mathematics learning. *Journal Of Mathematics Teacher Education*, 8(1)
- Beale, I. L. (2005). Scaffolding and intergrated assessment in computer assisted learning for children with learning disabilities. *Australasian Journal of Educational Technology*, 21(2), 173-191.
- Berk, L. (2006). *Child Development*. (7th Ed.). Boston: Allyn and Bacon
- Bodrova, E. & Leong, D. (1996). *The Vygotskian Approach to Early Childhood*. Columbus, Ohio: Merrill, an Imprint of Prentice Hall
- Brown, K. (2000). What kind of text - For whom and when? Textual scaffolding for beginning readers. *The Reading Teacher*, 53(4), 292-307.
- Chinnappan, M. (2003). The effect of scaffolding on knowledge production during mathematical problem solving. *International Journal of Curriculum and Instruction*, 5(1), 3-18.
- Coltman, P., Petyaeva, D. & Anghileri, J. (2002). Scaffolding learning through meaningful tasks and adult interaction. *Early Years: An International Journal of Research and Development*, 22(1), 39-49.
- Cresswell, J., Underwood, C., Withers, G. & Adams, I. (2002). Evaluation of the University of Canberra Programme for Advanced Literacy Development Scaffolding. *Literacy Programme with Indigeneous Children in School*. Canberra: ACER, DEST.
- Daniels, H. (2001) *Vygotsky and Pedagogy*. NY: Routledge/Falmer
- Department of Education Science & Training (DEST) (2001) Improvement or Transformation: Proceedings of the National Conference on Quality Teaching. Canberra: Australian Government. URL (last accessed 22.04.2007): http://www.dest.gov.au/sectors/school_education/programmes_funding/programme_categories/professional_skills_leadership/national_conference_on_quality_teaching_proceedings.htm
- DEST (2004). *Researching numeracy teaching approaches in primary schools*. Canberra: Australian Government. URL (last accessed 22.04.2007): http://www.dest.gov.au/sectors/school_education/publications_resources/literacy_numeracy/researching_numeracy_teaching.htm
- Dufficy, P. (2001). Scaffolding and assisted performance in multilingual classrooms. *Journal of Educational Enquiry*, 2(1), 33-49.
- Elliot, A. (1993). *Metacognitive teaching strategies and young children's mathematical learning*. Australian Association for Research in Education (AARE) Conference. Freemantle, W.A.
- Ewing, R. A., Smith, D. & Horsley, M (2003). An Inquiry, Case Based Approach to Teacher Education, *Change: Transformations in Education*, Vol. 6.2, pp. 46-56
- Floyd, D. B. & Bodur, Y. (2005). Using Case Study Analysis and Case Writing to Structure Clinical Experiences in a Teacher Education Program. *The Education Forum*, Vol 70, No 1, pp 42-60
- Fournier, D. N. E. & M. F. Graves (2002). Scaffolding adolescents' comprehension of short stories. *Journal of Adolescent & Adult Literacy*, 46(1), 30-39.

- Jacobs, G. (2001). Providing the scaffold, A model for early childhood/primary teacher preparation. *Early Childhood Education Journal*, 29(2), 125-130.
- Herrington, J. & Oliver, R. (1995). Critical characteristics of situated learning: Implications for the instructional design of multimedia. In J. E. A. Pearce (Ed.), *Learning with technology* (pp. 235-262). Parkville, Vic: University of Melbourne.
- Kong, A. (2002). Scaffolding in a learning community of practice, A case study of a gradual release of responsibility from the teacher to the students. *47th Annual Reading Association Convention*. San Francisco.
- Krause, K., Bochner, S. & Duchesne, S. (2006). *Educational Psychology for Learning and Teaching*. 2nd Ed. Australia: Thomson
- Larkin, M. (2001). Providing support through independent instruction. *Teaching Exceptional Children*, 34, 30-34.
- Madsen, J. & Gudmundsdottir (2000). Scaffolding children's learning in the zone of proximal development, A classroom study. Annual Meeting of the European Conference on Educational Research.
- Manouchehri, A. & Enderson, M. C. (2003). The Utility of Case Study Methodology in Mathematics Teacher Preparation. *Teacher Education Quarterly*, Vol. 30 (1), pp. 113-129
- Mariage, T. V., Englert, C. S and Garmon, M.A. (2000). The teacher as More Knowledgeable Other in assisting literacy with special needs students. *Reading and Writing Quarterly*, 16, 299-336.
- Mayo, J. A. (2004) Using Case-Based Instruction to Bridge The Gap Between Theory and Practice in Psychology of Adjustment. *Journal of Constructivist Psychology*, Vol 17 (2), pp. 137-146
- McLoughlin, C., & Marshall, L. (2000). *Scaffolding: A model for learner support in an online teaching environment*. Paper presented at the 9th Annual Teaching Learning Forum, Perth: Curtin University of Technology. <http://lsn.curtin.edu.au/tlf/tlf2000/mcloughlin2.html> (Accessed 16.03.2007)
- Michell, M. & T. Sharpe (2005). Collective instructional scaffolding in English as a second language classrooms. *Prospect*, 20(1), 31-58.
- Morrone, A.S., Harkness, S.S., D'Ambrosio, B., & Caulfield, R. (2004). Patterns of instructional discourse that promote the perception of mastery goals in a social constructivist mathematics course. *Educational Studies in Mathematics*, 56, 19-38
- Mousley, J. (2001). Theories of Learning: What's Next? From constructivism to activity theory. *Vinculum*, 39, 8-14.
- Nir-Gal, O. & P. S. Klein (2004). Computers for cognitive development in early childhood, The teacher's role in the computer learning environment. *Information Technology in Childhood Education Annual*. Norfolk, VA, AACE. 1, 97-119.
- NSW Institute of Teachers (NSWIT) (2006) *Professional Teaching Standards*. Sydney: Author
- Nunokawa, K. (2005). Mathematical problem solving and learning mathematics, What we expect students to obtain. *The Journal of Mathematical Behavior*, 24(3-4), 325-340.
- O'Toole, T. & C. Plummer (2004). Social Interaction, A vehicle for building meaning. *Australian Primary Mathematics Classroom*, 9(4), 39-42.
- Rasmussen, J (2001). The importance of communication in teaching: a systems-theory approach to the scaffolding metaphor. *Curriculum Studies*, 33 (5), 569-582.

- Roehler, R. L. & Cantlon, J. D. (1996). Scaffolding, A powerful tool in social constructivist classrooms. *Master of Arts. Literacy and Language Instruction*, Michigan State University. <http://ed-web3.educ.msu.edu/literacy/projects.htm> (accessed 16.03.2007)
- Seng, S. H. (1997). Zone of proximal development and the world of the child. Educational Research Association Conference. Singapore.
- Siemon, D., & Virgona, J. (2003). Identifying and describing teachers' scaffolding practices in mathematics, *NZARE/AARE Conference*. Auckland, New Zealand. URL <http://www.aare.edu.au/indexpap.htm>
- Sullivan, P., Mousley, J. & Zevenbergen, R. (2006) Developing Guidelines for Teachers Helping Students Experiencing Difficulty in Learning Mathematics. In P. Grootenboer, R. Zevenbergen, & M. Chinnappan (Eds.), *Identities, Cultures and Learning Spaces. Proceedings of the 29th Conference of MERGA* (pp. 519-528). Adelaide, SA: MERGA Inc.
- Tudge, J. (1990). Vygotsky, the Zone of Proximal Development, and Peer Collaboration: Implications for Classroom Practice. In Moll, L.C. (Ed.), *Vygotsky and Education: Instructional Implications and Applications of Sociocultural Psychology*. Cambridge: Cambridge University Press.
- Verenikina, I. & Chinnappan, M. (2006) Scaffolding Numeracy: Pre-service Teachers' Perspective. In P. Grootenboer, R. Zevenbergen & M. Chinnappan (Eds.) *Identities, Cultures and Learning Spaces. Proceedings of the 29th Conference of MERGA. Vol. 2* (pp. 519-528). Adelaide: MERGA Inc.
- Verenikina, I. (2004). From theory to practice: What does the metaphor of scaffolding mean to educators today? *Outlines*, Vol. 6/ 2, pp. 5-15.
- Vialle, W., Lysaght., P., & Verenikina, I. (2005). *Psychology for Educators*. Melbourne: Thomson/Social Science Press.
- Vygotsky, L. S. (1978). *Mind in Society: The Development of Higher Psychological Processes* (M. Cole, V. John-Steiner, S. Scribner, & E. Souberman, Eds.) Cambridge, MA: Harvard University Press
- Wells, G. (1999) *Dialogic Inquiry: Towards a Sociocultural Practice and Theory of Education*. New York: Cambridge University Press
- Hedegaard, M. (2002). Learning and Child Development. A cultural-historical study. Aarhus University Press: Denmark.
- Wertsch, J. V. (1998). *Mind as Action*. Oxford: Oxford University Press.
- Wood, K. & S. Frid (2005). Early childhood numeracy in a multiage setting. *Mathematics Education Research Journal*, 16, 80-99.
- Yaroshevsky, M. (1989). *Lev Vygotsky*. Moscow: Progress Publishers