SUPPORTING SELF-REGULATED LEARNERS FOR A WHILE AND WHAT COMPUTERS CAN CONTRIBUTE

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ABSTRACT

This article's main claim is that to support individuals' development toward becoming self-regulated learners requires certain amounts of other-regulation, i.e. scaffolding. Starting from this assertion, we discuss 6 issues that surfaced in the 5 articles of this special issue. First, we argue that designers need good reasons for taking freedom away from the learners. Beyond practical reasons, we suggest that the reduction of freedom should more often be warranted in theoretical considerations. Second, as the articles in this special issue show, other-regulation can come from a variety of external sources like software tools, peers, or teachers. However, one critical issue for the design of other-regulation seems to be its degree of coercion. Third, by reviewing the empirical results of the single articles, it can be inferred that learners with different prerequisites do not benefit equally from the scaffolds reported in this special issue. In the fourth section of this discussion, we therefore argue that inter- and intra-individual differences are key challenges for the design of instruction for self-regulated learning and, fifth, that digital media have a strong potential to provide adaptive instructional support for learners with different prerequisites. They might be used to dynamically assess the learners' internalization of self-regulated learning strategies and fade single scaffolds in and out of the learning environment as appropriate. Finally, we argue that, especially in institutionalized learning settings, designers of instruction need to consider how best to orchestrate different sources of other-regulation in order to successfully facilitate the development of self-regulated learners.

INTRODUCTION

The articles in this special issue deal with a learning phenomenon that has attracted instructional psychology's attention for the past few decades: self-regulated learning. Individuals who are competent in self-regulating their learning are able to quickly understand an existing problem, set realistic but challenging learning goals, create adequate plans to achieve those goals, enact appropriate learning strategies, regulate their motivation, and continuously monitor their learning progress (e.g., Pintrich, 2000; Winne, 2001; Zimmerman & Schunk, 2001). Enabling an individual to become a self-regulated learner is truly one of the most challenging and idealistic goals in instructional psychology.

Yet, although it may sound paradoxical, achieving this goal typically requires putting individuals in learning situations with certain degrees of other-regulation. Research has repeatedly demonstrated that having learners work on problems without external guidance very rarely leads to desired learning outcomes in terms of domain-specific knowledge or domain-general competences (see Kirschner, Sweller, & Clark, 2006; Kollar, Fischer, & Slotta, 2005; Mayer, 2004). Instructional guidance, in whatever form, seems to be necessary to give especially novice learners the opportunity to gradually develop abilities and competences for self-regulated learning that ultimately are applicable in a variety of learning contexts.

In this discussion, we focus on six issues that more or less explicitly surfaced in the five articles of this special issue. First, we look at the arguments that can be made (and have been made in this special issue) to take away the learners′ freedom and to provide them with a certain amount of other-regulation. Then, we outline different forms of other-regulation that may contribute to the development of an individual toward becoming a self-regulated learner and relate these considerations to theoretical approaches from distributed cognition (e.g., Perkins, 1993). After that, we review the empirical results of the articles in this special issue to answer the question whether constraining freedom and providing other-regulation does really help learners develop strategies for self-regulated learning. Taking the results of the articles into account, we then argue that inter- and intra-individual differences are a key challenge for the design of instruction for self-regulated learning. After that we discuss the role digital media can play for instructional design promoting self-regulation. Finally, we suggest future research to systematically analyze what can be done to realize a successful orchestration of different kinds of other-regulation in the classroom.

WHY IMPOSE STRUCTURE AND PROVIDE SUPPORT TO OTHERWISE SELF-REGULATED LEARNERS?

As already mentioned, it seems necessary to provide learners with some amount of external guidance so that they can develop and gradually internalize strategies, abilities, and competences that are crucial for becoming self-regulated learners.

After all, however, constraining the processes of learning and interaction externally, even temporarily and even if initiated with a positive intention, can hardly be seen as self-regulation of a self-determined learner (see Berlin, 1958, for a more extensive discussion of different kinds of liberty, and Pea, 2006, for an application of these reflections onto research in the field of technology-enhanced learning). Therefore, designers of instruction need good reasons for why to take self-regulation away from the learners. The articles in this special issue give rather similar reasons for this. With the exception of the study by Stahl, Pieschl, and Bromme (this issue), who did not investigate an instructional intervention, they all warrant their approaches for an other-regulation of the individuals' or groups' learning processes by pointing to practical problems that often show up in the examined learning scenarios when no other-regulation is provided. For example, Zumbach, Reimann, and Koch (this issue) argue that especially in Web-based learning settings, members of learning groups often lack adequate collaboration strategies to engage in successful collaboration, while Bannert (this issue) at least implicitly suggests that students often do not apply sophisticated metacognitive strategies in learning situations in which they would be of importance. In our view, such practical considerations are only one—though reasonable—way to warrant the realization of other-regulation. Another way to warrant the decision to include other-regulation would be a theory—rather than a phenomenon-driven approach. The article by Stahl et al. (this issue) nicely demonstrates this approach by connecting research on epistemological beliefs with the COPES-model of self-regulated learning that was proposed by Winne and Hadwin (1998). From these theoretical considerations, the authors convincingly conclude that learners with naïve epistemological beliefs can be expected to have problems at various stages of a selfregulated learning process. It is then easy to infer that learners with naïve epistemological beliefs require differently designed instruction than learners with sophisticated epistemological beliefs. We believe that such theory-driven approaches have a high potential to inform the design of learning environments aimed at the facilitation of self-regulated learning.

THERE ARE MANY SOURCES AND TYPES OF OTHER-REGULATION

From a distributed cognition perspective, individuals can be considered to form a system with their immediate surround. This system consisting of the individual and the surround participates in cognitive activities like learning or problem-solving. The "surround" encompasses both artifacts and other persons and can provide other-regulation for the "person-solo" (Perkins, 1993). Thus, other-regulation can come from multiple external sources such as peers, teachers, external tools (like a hand calculator), or instructional scaffolds.

In the articles of this special issue, other-regulation was provided by a variety of external sources in the surround-component of a person-plus-surround-system. In the article by Ertl, Kopp, and Mandl (this issue), other-regulation was achieved by a content scheme and a collaboration script. In the article by Zumbach et al. (this issue), other-regulation was provided by a computer system that displayed current participation rates as well as emotional and motivational states of the learners to the single group members (study 1) and by a human tutor who constantly evaluated the collaborative events that occurred within the learning groups and gave feedback (study 2). In the study by Bannert (this issue), other-regulation was realized by an experimenter who prompted the learners to explain their navigation decisions. Nesbit et al. (this issue) provided learners with the gStudy software that offered them a variety of support measures like a highlighting and a note-taking function without, however, explicitly forcing or asking learners to use them. In the two studies investigating groups of learners (Ertl et al., this issue, and Zumbach et al., this issue), the single learners might also have provided other-regulation for their peers, for example by proposing how to approach the learning task.

Taking a glance at these different instructional interventions realized in the studies in this special issue, it is evident that other-regulation cannot only be provided by different external actors or tools (like co-learners, experimenters, software tools, content schemes, etc.) but that it can also be realized with different degrees of explicitness or "coercion" (Dillenbourg & Jermann, in press). While the content scheme and the collaboration script used by Ertl et al. (this issue) as well as the reflection prompts by Bannert (this issue) can be considered as a rather explicit and coercive way of structuring the learning process, providing computerized highlighting and note-taking tools that may or may not be used by learners in the study by Nesbit et al. (this issue) as well as the feedback approach by Zumbach et al. (this issue) can be regarded as less explicit and coercive interventions. However, both strategies still represent forms of other-regulation. As we will argue later, research needs to investigate in more detail what types of learners need what types of other-regulation and with what degrees of coercion. However, when considering the empirical results that were obtained in the studies of this special issue, other-regulation as such seems to be necessary for the development of individuals towards becoming self-regulated learners.

CONSTRAINING FREEDOM—DOES IT REALLY HELP?

When looking at the empirical results obtained in the studies of this special issue, it appears that providing other-regulation can indeed facilitate self-regulated learning. Ertl and colleagues (this issue) found that their content scheme strongly improved the learning groups' collaborative case solution. Zumbach et al. (this issue) found indicators that the distribution of learning resources and the provision of feedback concerning the groups' collaboration processes can improve the frequency of collaborative events and the group climate and that at least feedback can have a positive impact on the collaborative case solution. Bannert (this issue) found that asking learners to explain their navigation behavior in a hypertext environment can improve performance on transfer tests. And Nesbit and colleagues (this issue) found that at least learners with a mastery orientation can be supported by a computer-based learning environment that offers a variety of learning support mechanisms they can choose from to solve a particular learning task. Taking the results of the Stahl et al. (this issue) study into account, similar results may be expected for learners with sophisticated instead of naïve epistemological beliefs.

However, the results of the single articles also demonstrated that not all kinds of other-regulation are equally effective. For example, Bannert (this issue) concludes from her results that reflection prompts for hypertext navigation might be especially fruitful for learning when designed in a way that triggers adequate strategic decisions. Zumbach et al. (this issue) suggest that management-based scaffolding like displaying participation rates of the individuals to the single group members is a more effective approach than the design-based approach of distributing learning material. Ertl and colleagues (this issue) demonstrate that within such design-based approaches, providing learners with content schemes seems to be more promising than the provision of collaboration scripts, at least with respect to the quality of the collaborative case solution. The results of the Nesbit et al. (this issue) study seem to indicate that rather open, affordance-oriented computer-based learning environments are effective for learners exhibiting a mastery goal orientation, whereas learners holding a performance avoidance goal might be better off in more constrained environments which provide them with more direct instructions.

In our view, especially this last result points to an important question for future theory-building and research on self-regulated learning, namely the question to what extent individual learner characteristics need to be considered in the design of scaffolds for self-regulated learning. This question can be approached both from an inter-individual and an intra-individual perspective, as will be described in the following section.

INTER- AND INTRA-INDIVIDUAL DIFFERENCES AS CHALLENGES FOR DESIGNING INSTRUCTIONAL SUPPORT

As numerous empirical studies and theoretical articles indicate, individuals do not enter learning situations as a tabula rasa. Instead, they exhibit certain cognitive, motivational, and attitudinal characteristics that at least partially determine the development of self-regulated learning strategies (e.g., Dochy, Segers, & Buehl, 1999; Neber & Schommer-Aikins, 2002). Different learner characteristics may thus call for different kinds of other-regulation, i.e., instructional interventions (see also Dillon & Gabbard, 1998). For the design of self-regulated learning (or other-regulated learning that is aimed at a facilitation of self-regulated learning, to be more precise), one main question is what metacognitive tasks like planning, controlling, and monitoring of individual or collaborative learning processes (Perkins, 1993, would call this the "executive function") should be transferred to the person-solo's surround. It seems plausible that for learners who possess characteristics that allow them to take over the executive function, there would be no need to design an "instructional surround" that provides additional metacognitive control. For example, assuming that learners already hold highly developed internal scripts (Schank & Abelson, 1977) that guide them in successful collaboration, they do not require external collaboration scripts to receive additional guidance (see Kollar et al., 2005). The articles of this special issue, especially the results obtained by Stahl et al. (this issue) and Nesbit et al. (this issue), document these different instructional needs for learners with different prerequisites. Beyond epistemological beliefs and motivational goal orientation, there are surely many more individual learning prerequisites that make different degrees of other-regulation in the used instructional interventions necessary. In our view, future research on this issue is most helpful when it connects its assumptions on the influence of its favorite individual factor to existing theories of self-regulated learning, as was done by Stahl and colleagues (this issue).

Just as there may be inter-individual differences that need to be accounted for by an appropriate instructional design, the same is true for intra-individual differences. As we have argued, self-regulated learning represents an important and ultimate goal of instruction and the development toward becoming a selfregulated learner must be regarded as a gradual process. This means that individuals, on their way to becoming self-regulated learners, pass a number of developmental stages that obviously require different degrees of other-regulation. From an instructional perspective, as learners gradually develop more sophisticated self-regulated learning strategies and thus are gradually becoming more capable in taking the executive function over their learning process, metacognitive control should gradually be removed from the instructional surround. In the literature on scaffolding, such a gradual reduction of instructional prescriptions has been termed *fading* (Atkinson, Renkl, & Merrill, 2003; Collins, Brown, & Newman, 1989; Leutner, 2000). According to Pea (2004), fading is a requirement for instructional support or scaffolds for an internalization of learning strategies or tactics to happen. If there is no fading, he argues, the individual will not see the reason for why to internalize the strategy that is supported by the instructional intervention. In this case, the external tool does not represent a "scaffold" but rather a case of "distributed intelligence" (Pea, 2004, p. 431), which describes an external tool that can be used to off-load tasks that require strategies that do not need to be internalized. In the empirical studies reported in this special issue, however, no fading methods were realized. Instead, the instructional interventions were present throughout the complete learning phases, which might be due to the rather short intervention periods realized in the empirical studies. If longer learning phases had been realized, the authors would have strongly been forced to think about how the presented instructional interventions could gradually be faded out. Yet we argue that, if the aim is to support a development toward self-regulated learning, effective fading is one of the most important issues for instruction. Moreover, it is one of the most interesting aspects to the facilitation of self-regulated learning that can be achieved by the use of digital media, as is described in the following section.

POTENTIALS OF DIGITAL MEDIA FOR THE FACILITATION OF SELF-REGULATED LEARNING

As the articles in this special issue show, digital media can adopt several roles to support self-regulated learning. In this section, we focus on four of them, which to us seem especially interesting.

First, and most obviously, digital media can be used to create learning environments that provide opportunities for self-directed learning and exploration. In fact, hypermedia environments as used by Bannert (this issue), Zumbach et al. (this issue), and Nesbit et al. (this issue) are widely regarded as ideal environments for the realization of self-regulated learning because they allow for high degrees of learner control (Azevedo, 2005): Learners can determine by themselves what information they want to review, in what temporal order, and how long to review certain information.

However, research has often documented that learners may be overwhelmed by the openness of such learning environments and experience what has been called the "lost in hyperspace" phenomenon (Conklin, 1987). Therefore, and as a second function of computer media in self-regulated learning, they can be used to reduce freedom by constraining the space of possible actions to those that seem productive for learning. This has clearly been the case in the approach by Ertl et al. (this issue). Through the provision of a collaboration script, the set of possible actions is constrained to a group of actions that have been considered as conducive for learning by the designers of the script.

Third, digital media can be used to implement scaffolds for meaningful activities. This is the case when content schemes or collaboration scripts (Ertl et al., this issue), reflection prompts (Bannert, this issue), feedback mechanisms (Zumbach et al., this issue), or highlighting and note-taking tools (Nesbit et al., this issue) are integrated in the computer (or communication) interface. All of these scaffolds are aimed at supporting learners to engage in learning processes they would not be able to engage in on their own (see Wood, Bruner, & Ross, 1976 for the roots of the term "scaffolding"). Although sometimes implicitly, this scaffolding function can be attributed to all instructional interventions that were reported in this special issue, even more since all of the authors state that the reasons for why they realize other-regulation were to overcome problems that are typical in unguided learning situations.

Finally, and in relation to what has already been said about the relation between other- and self-regulation during the acquisition of strategies for self-regulated learning, digital media can be used to realize adaptive fading of instruction.

Effective fading, however, requires sophisticated methods for assessment. In computer-supported learning environments, such assessment may be conducted by technologies, and its results can automatically be used to change the scaffolding. For example, at the beginning of a learning session, a scaffold might demand a learner to explicitly name a piece of evidence she wants to build her argument on. Later on, when the computer system diagnoses that the learner has internalized the argumentation strategy of "backing up claims with evidence" and produced a number of arguments that include evidence, this component of the scaffold might be faded out. Such adaptive learning environments have already been developed for well-defined domains like geometry and algebra (Intelligent Tutoring Systems; e.g., Anderson, Corbett, Koedinger, & Pelletier, 1995). For ill-defined domains, such learning environments are still rare, mostly because of the problem how to validly assess the individuals' progress in the acquisition of the aimed at self-regulated strategies. Yet, efforts are currently being undertaken to develop algorithms that can be used by machines to analyze computer-mediated discourse (Dönmez, Rosé, Stegmann, Weinberger, & Fischer, 2005; Erkens, & Janssen, 2006) and feed this information back to fade scaffolds in or out as appropriate. If these developments prove to be successful, the design of computer-supported learning environments that effectively and adaptively scaffold the acquisition of self-regulated learning strategies can become more than a vision. However, besides technological problems that need to be solved there are also conceptual ones. For example, especially in ill-defined domains, clear models of the competences that are to be facilitated by a specific instructional intervention are needed. Only when such models are available, algorithms can be developed that can adapt to learner behavior that indicates that the aimed-at competence is not yet acquired by the learner.

Of the approaches presented in this special issue, the work by Zumbach et al. (this issue) already points into this direction. There, particular collaboration processes and motivational as well as emotional learner variables are assessed online. Yet, the results of these assessments are not fed back into a dynamic adjustment of the learning environment but instead re-presented to the single group members who then—in the ideal case—take adequate actions to cope with obvious collaboration-, motivation-, or emotion-related problems. This strategy seems to be highly reasonable, when—as the results of the studies by Stahl et al. (this issue) and Nesbit et al. (this issue) indicate—the learners exhibit characteristics that allow them to "calibrate" their actions toward this information or—as we have argued—when the learners have already significantly progressed in their development toward becoming self-regulated learners. For learners with less advantageous prerequisites and for novices in self-regulated learning, this strategy however is likely to overstrain them so that a dynamic adjustment of the realized other-regulation in the learning environment might be more promising. Additional evidence in this respect comes from research on help-seeking in online environments, where it has been shown that weak learners are also very likely to be weak help seekers, for example, because they often do not realize that they need help (Aleven, Stahl, Schworm, Fischer, & Wallace, 2003). However, extensive efforts still need to be undertaken to investigate the effects of fading scaffolds for central learning-related variables in and out and to make it a standard in computer-supported learning. Prior research demands us however to remain very critical about the possibility to design automated or intelligent teaching machines. Perhaps it is a more realistic expectation to develop intelligent tools for institutionalized learning settings in which a teacher uses the suggestions of a machine to decide on adapting the scaffolding for specific learning groups or individuals.

ORCHESTRATING COMPUTER-SUPPORTED PROCESSES OF (INCREASINGLY) SELF-REGULATED LEARNING

Against the background of what was just said, one central challenge for the design of instruction, especially when it comes to classroom and university learning, is their successful *orchestration* (Fischer & Dillenbourg, 2006). Ideally, other-regulation provided by digital technologies and by a teacher should be designed in a way that both kinds of scaffolds combine in a way that is conducive for the targeted learners. Tabak (2004) used the term *synergistic scaffolding* to describe this instance. For example, small groups of learners may work with a computer-based tool that is designed to support their learning processes (e.g., a computer simulation that allows to manipulate the number of predators and prey in an ecological habitat). Especially when the learners are not yet familiar with the tool and its value for the learning process, the teacher may further support them in how to use the tool and explain its value. Afterwards, ideally the small group is able to develop ideas concerning the problem at hand with the tool and without further support of the teacher. Thus, the computer-based scaffold and the teacher have mutually amplified their effects. In the articles reported in this special issue, we find two studies that empirically investigated the combination of two sources of other-regulation. In study 2 of the Zumbach et al. (this issue) article, the distribution of learning materials and feedback on participation, emotion, and motivation were combined and compared to learning groups in which the learning material was not distributed or non-feedback groups. The results indicated that at least concerning the frequency of collaborative events, there was a synergistic scaffolding effect: The combination of distributing learning materials and the provision of feedback led to higher numbers of collaborative events than did each of the two scaffolds alone. In the study by Ertl et al. (this issue), a content scheme and a script were used in combination. However, since the collaboration script did not yield significant effects on the processes and outcomes of the collaborative case solution, no synergistic scaffolding effect could be observed. Yet, more studies are needed to investigate in how far different (artifactual and social) scaffolds can be orchestrated to provide an optimum degree of other-regulation in order to create learning environments that really are effective in supporting individuals' development toward becoming self-regulated learners.

REFERENCES

Aleven, V., Stahl, E., Schworm, S., Fischer, F., & Wallace, R. (2003). Help seeking in interactive learning environments. *Review of Educational Research, 73*(3), 277-320.

Anderson, J. R., Corbett, A. T., Koedinger, K. R., & Pelletier, R. (1995). Cognitive tutors: Lessons learned. *Journal of the Learning Sciences, 4,* 167-207.

Atkinson, R. K., Renkl, A., & Merrill, M. M. (2003). Transitioning from studying examples to solving problems: Combining fading with prompting fosters learning. *Journal of Educational Psychology, 95,* 774-783.

Azevedo, R. (2005). Using hypermedia as a metacognitive tool for enhancing student learning? The role of self-regulated learning. *Educational Psychologist, 40*(4), 199-209.

Berlin, I. (1958). *Two concepts of liberty*. Oxford: Clarendon Press.

Collins, A., Brown, J. S., & Newman, S. E. (1989). Cognitive apprenticeship: Teaching the crafts of reading, writing, and mathematics. In L. B. Resnick (Ed.), *Knowing, learning, and instruction. Essays in the honor of Robert Glaser* (pp. 453-494). Hillsdale, NJ: Lawrence Erlbaum Associates.

Conklin, J. (1987). Hypertext: A survey and introduction. *IEEE Computer, 20*(9), 17-41.

Dillenbourg, P., & Jermann, P. (in press). Designing integrative scripts. In F. Fischer, I. Kollar, H. Mandl, & J. M. Haake (Eds.), *Scripting computer-supported collaborative learning: Cognitive, computational, and educational perspectives.* New York: Springer.

Dillon, A., & Gabbard, R. (1998). Hypermedia as an educational technology: A review of the quantitative research literature on learner comprehension, control, and style. *Review of Educational Research, 68*(3), 322-349.

Dochy, F., Segers, M., & Buehl, M. M. (1999). The relation between assessment practices and outcomes of studies: The case of research on prior knowledge. *Review of Educational Research, 69*(2), 145-186.

Dönmez, P., Rosé, C., Stegmann, K., Weinberger, A., & Fischer, F. (2005). Supporting CSCL with automatic corpus analysis technology. In T. Koschmann, D. Suthers, & T.-W. Chan (Eds.), *Computer supported collaborative learning 2005: The next 10 years!* (pp. 125-134). Mahwah, NJ: Lawrence Erlbaum.

Erkens, G., & Janssen, J. (2006). Automatic coding of communication in collaboration protocols. *Proceedings of the 7th international conference of the learning sciences—Making a difference (June 12 – July 1 2006)* (pp. 1063-1065). Bloomington, IN.

Fischer, F., & Dillenbourg, P. (2006, April). *Challenges of orchestrating computer-supported collaborative learning.* Paper presented at the 87th Annual Meeting of the American Educational Research Association (AERA), San Francisco, CA.

Kirschner, P.A., Sweller, J., & Clark, R.E. (2006). Why minimal guidance during instruction does not work: An analysis of the failure of constructivist, discovery, problem-based, experiential, and inquiry-based teaching. *Educational Psychologist, 41*(2), 75-86.

Kollar, I., Fischer, F., & Slotta, J. D. (2005). Internal and external collaboration scripts in web-based science learning at schools. In T. Koschmann, D. Suthers, & T.-W. Chan

(Eds.), *Computer supported collaborative learning 2005: The next 10 years!* (pp. 331-340). Mahwah, NJ: Lawrence Erlbaum Associates.

Leutner, D. (2000). Double-fading support—A training approach to complex software systems: theory, instructional model, and two training experiments. *Journal of Computer-Assisted Learning, 16,* 347-357.

Mayer, R. E (2004). Should there be a three-strikes rule against pure discovery learning? *American Psychologist, 59*(1), 14-19.

Neber, H., & Schommer-Aikins, M. (2002). Self-regulated science learning with highly gifted students: The role of cognitive, motivational, epistemological, and environmental variables. *High Ability Studies, 13*(1), 59-74.

Pea, R. D. (2004). The social and technological dimensions of scaffolding and related theoretical concepts for learning, education, and human activity. *Journal of the Learning Sciences, 13*(3), 423-451.

Pea, R. D. (2006, April). Discussant's contribution to the Symposium on Integrating self-directed learning and intelligent tutoring: a research agenda for educational reform. Annual Meeting of the American Educational Research Association, San Francisco, CA.

Perkins, D. N. (1993). Person-plus: a distributed view of thinking and learning. In G. Salomon (Ed.), *Distributed cognitions: psychological and educational considerations* (pp. 88-110). Cambridge: Cambridge University Press.

Pintrich, P. R. (2000). The role of goal orientation in self-regulated learning. In M. Boekaerts, P. Pintrich, & M. Zeidner (Eds.), *Handbook of self-regulation* (pp. 451-502). San Diego, CA: Academic Press.

Schank, R. C., & Abelson, R. P. (1977). *Scripts, plans, goals and understanding.* Hillsdale, NJ: Erlbaum.

Tabak, I. (2004). Synergy: A complement to emerging patterns of distributed scaffolding. *The Journal of the Learning Sciences, 13*(3), 305-335.

Winne, P. H. (2001). Self-regulated learning viewed from models of information-processing. In B. J. Zimmerman & D. H. Schunk (Eds.), *Self-regulated learning and academic achievement: Theoretical perspectives* (pp. 153-189). Mahwah, NJ: Lawrence Erlbaum Associates.

Winne, P. H., & Hadwin, A. F. (1998). Studying as self-regulated learning. In D. J. Hacker, J. Dunlovsky, & A. C. Graesser (Eds.), *Metacognition in educational theory and practice* (pp. 277-304). Mahwah, NJ: Lawrence Erlbaum Associates.

Wood, D. J., Bruner, J. S., & Ross, G. (1976). The role of tutoring in problem-solving. *Journal of Child Psychology and Psychiatry, 17,* 89-100.

Zimmerman, B. J., & Schunk, D. H. (2001) (Eds.). *Self-regulated learning and academic achievement: Theoretical perspectives.* Mahwah, NJ: Lawrence Erlbaum Associates.