Scaffolding support in an ecology course using a sociocultural learning design

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An ecology course at our university was redesigned as it was felt the learners needed more support to help them gain a deeper knowledge of ecology concepts, terminology and professional practice. A learning design based on Vygotsky's sociocultural theories was used to structure the learning environment. This learning design scaffolds the learning in a more comprehensive manner as it proposes that learning is mediated by others and describes the type of support is required. This paper presents the theoretical basis of the learning design, and how this is used to design the ecology project to help increase learning outcomes. Evaluation of the design will be carried out later this year.

Keywords: sociocultural, learning design, scaffold, Vygotsky, project-based

Introduction

Students graduating from a final year undergraduate ecology course at this university often have difficulties in using their knowledge to talk about ecology or to apply their learning in the workplace. Therefore, it was felt that the course needed to be redesigned in such a way to develop more usable cognitive skills in the students. A project-based course design was chosen, but it was known that students would need more support than is provided in a constructive or socioconstructive approach. Therefore Vygotsky's sociocultural theories were used as the basis for the learning design. As these theories propose that learning is mediated, learning design based on this principle results in a learning environment that is more comprehensively scaffolded than those guided by other theoretical approaches. The ecology course will plan to have three projects, but one is being done at this stage as a pilot to determine what modifications would be needed to help meet the identified learning needs.

Sociocultural theory

Sociocultural theories propose that learning is an active process and that the context has a vital role in learning. These theories originated in the work of Vygotsky (1978) who proposed that the social environment is necessary for learning. Other sociocultural theories such as situated cognition and cognitive apprenticeships also stress the importance of the social environment, and the mentoring of students by experts. However, there are some aspects of the sociocultural theories, as proposed by Vygotsky and later developed by post-Vygotskyists that are not emphasised in today's active learning and student-centred approaches but are important in supporting learning.

Learning is mediated

Vygotsky proposed that learning is mediated. This means other people must interact with the learner and teach them how to use mediator tools. These tools are "psychological" (Vygotsky, 1978 p 53) in nature, in that they are used to express thinking, and include language, signs, symbols, texts and mnemonic techniques. Therefore in the design of learning, this means that:

- The support of learning starts with the learning of the new tools, the signs, symbols and concepts that the learners will use in the new learning context. These should be taught before any activity is accessed as "learning precedes development" (Artiles *et al.*, 2000 p 81). Thus, the lecture or the formal aspect of learning is used to help the learners to understand how to use the tools. The focus of the lesson should be on the tools, with an emphasis on their meaning and their use (Karpov, 2003).

There should also be activities that provide opportunity for learners to develop a greater understanding of the new tools.

- The second step in the learning process is the use of activities, where the learners require support as they begin to internalise the concepts, language and symbols in expressing their thoughts in solving problems. As these tools are psychological, learners need social activities for using the new language in their discussions and so learn how to talk and think like professionals. Thus the lesson provides the learning about the new tools, but the activities provide the social support where they have the opportunity to develop competence in using these new tools to express their thinking.

Thus support is scaffolded from the initial component of a course, in the lecture or online notes, and then as the students are guided first in understanding the concepts and then in how to use them in their thinking.

The social environment is vital

As mediation is vital in the learning process, the impact of the social environment on learning can be seen in that the experts, such as teachers, select and teach tool use. This affects the way that the learners express their thinking (Cole & Wertsch, 2001; John-Steiner & Mahn, 1996). Therefore the learning environment should activities that are social and are authentic. Social activities provide learners with the support and opportunity to learn how to use the tools and gain competency, as using these tools actively can build "useful robust knowledge" (Brown, Collins & Duguid, 1989, p 33). Thus students begin to use domain concepts in their interaction to express new thinking. These social activities are required from the initial stages of the course as this environment is where the learning occurs. Authentic activities enable learners to use domain knowledge in the same way practitioners would, as this helps enrich understanding of the tools (Brown, Collins & Duguid, 1989). Therefore the type of situation that is required for this interaction is tasks or problems that would normally be done by those in the field. These tasks may be simple or complex, depending on the learners' levels, but they must be authentic interactive activities that those communities would normally be involved in. Therefore the students must work consistently in the social environment from the initial part of the course, as both the teacher and peers in the authentic domain provide the support structure to develop new knowledge, and gain increasing competency in its use.

Learning is in the zone of proximal development

The Zone of Proximal Development (ZPD), proposed by Vygotsky (1978), describes the type of environment that enables the learner to develop cognitively. Learners need more mature people in the environment, but these people must be able to help the learners develop and enrich the particular psychological tools that are needed. As well, learners benefit only when they are ready for this next stage of development. If these factors are all present, then the learners' interaction in the social environment can able to help them achieve success in the learning activity in a way that they could not have done without the social support (Chaiklin, 2003; Karpov, 2003; Kozulin, 2003). Therefore this means that the teacher needs to be active during the implementation of the course in tracking the learners to provide timely and suitable feedback; ensuring learners have the support they need. Dolittle (1997) comments that this is important in ensuring the learners are working on task, and that each student is "both challenged and developing"(p 95) , that is, is working in their ZPD. Support can be provided through scaffolding, coaching and modeling (Brown et al., 1989; Rogoff, 1990). Also, individual tasks are required at the end of section of work. These enable the learners to demonstrate they are able to achieve in tasks using the new tools and no longer require the support of others. Thus, the support from the social environment must be designed at the right cognitive level, and with the right amount of support. This must be determined on the students' needs, to ensure that they will be able to learn effectively.

Ecology project design

The third year ecology course was redesigned as a student-centred project-based blended learning course. The final plan is to use three projects in this semester-long course, but at this stage, only one project has been designed. This is a pilot course that will be evaluated to determine its effectiveness in meeting the educational goals, and to determine which aspects of the design need to be modified to improve learning outcome. The project takes six weeks and is a case study that requires an investigation of a wadi to determine its ability to sustain a community. Most work is done in groups, with the final report to be completed individually. The learning design is shown in Table 1.

Table 1: Scaffolding provided in the project

Activity	Support provided	Learning design concepts
1. Orientation to course	* Guides for report writing * Examples of reports provided	* Scaffolding support in learners' ZPD * Introducing e-learning tools
2. Wadi (river)Visit: Observation of benefits of the wadi to the community	* Classroom lecture: focused on new concepts, available online as well * Online group chats * URLs with guides * Summaries posted for part one of project for peer evaluation * Teacher reads chat summaries and gives feedback online	* Mediating learning by teaching concepts first. *Chats for increased understanding of concepts in a social environment, mediating learning. * URL support as scaffolding * Group leaders provide group support * Feedback is a scaffold, and a check that learning support is sufficient for learning in ZPD.
3. Wadi Visit: Sample collections from, with observations of human impact.	* In class, groups prepare sampling lists & decide on sampling methods. * Lists of observation areas if needed * In online chats, discuss problems, post in workshop tool * Teacher checks next stage of projects posted online	* Project and this chat are based on an authentic topic, planned in a social environment. * Scaffolding provided, depending on students' ZPD * Chats will help students use concepts as tools to explain their thinking and as a support for each other. Topics deepen each week * Teacher provides more feedback as scaffolding, and to check learning.
4. Lab testing of samples, & discussion of their significance	* Classroom lectures handouts and websites provided online. * Tests performed in the lab and results are posted online, and checked by teacher. * Online chat conclusions concerning impact analysis are posted	* Lecture focuses on teaching new concepts, mediating learning for the next topic. * Learning applied to authentic field problem * In chats students use concepts to express thinking, and at deeper cognitive levels.
5. Analysis of trophic samples and their significance in the food web	* Classroom lecture introduces new concepts, and posted online. * Online discussions of concept meanings, and of significance of results * Wadi food webs constructed and shared, and checked by tutor.	* Lecture provides support for problem-solving, and mediates the learning process. * First discussion provides scaffolding and opportunity to increase understanding of concepts * Discussions mediate learning, using concepts to express thinking at higher cognitive levels * Active learning in analysis of wadi, with support
6. Individual Project Report completed	* Online group forum to analyse human impact. * Teacher monitors discussion and marks final individual reports	* Mediating competency in using new concepts to express thinking at higher levels in an authentic social environment. * Students demonstrate individual learning

Research method

An evaluation research will be done to determine how well the project design encouraged the development of cognitive skills, the ability to use domain concepts in discussing ecology topics, and whether the type and amount of support provided was sufficient. This will be used to propose changes for this project and guide the learning design for the other projects in a future ecology course. Online chats and forums will be analysed for cognitive levels and evidence of concept use based on tools such as those developed by Poole (2000) and Iding, Vick, Crosby and Auenheimer (2004) The use of scaffolding will be evaluated on learner's responses in the assignments, and from their comments in an online questionnaire. As the project will be piloted later this semester, results are not yet available.

Discussion and final remarks

As can be seen from the table, the use of a sociocultural learning design can result in the provision of scaffolding and support to enable students to first learn about, and then use new ecology concepts and principles in solving a genuine ecology problem. This scaffolding is provided in the way the lecture notes are designed, use of outlines and examples, the interaction topics, group work, and the way the teacher provides feedback. The interaction is designed to help students discuss the project using the ecology tools, and at increasing cognitive levels over the six weeks of the project. As the course is student-centred and project based, it means that the students learn how to learn from each other and from resources, not just from the teacher, and that the skills developed can be useful in the work place. The project is done in stages so that teacher can assess how well the students are learning, what extra scaffolding may be needed, and provide feedback during project work, instead of only when the project is completed. Therefore the students can learn to use ecology concepts, terminology and symbols, during the course,

and at increasing cognitive levels whilst working on an authentic activity. This should better prepare them in the way they talk about ecology and in for their future in their professional fields. However this project design will be evaluated for its abilities to meet these goals, so that modifications may be made to improve the design, and provide guidelines on how to design the complete course. This research will be done later this semester.

References

Artiles, A., Trent, S., Hoffman-Kipp, P., & Lopez-Torres, L. (2000). From individual acquisiton to cultural-historical practices in multicultural teacher education. *Remedial and Special Education, 21*(2), 79- 90. https://doi.org/10.1177/074193250002100203

Brown, J. S., Collins, A., & Duguid, P. (1989). Situated cognition and the culture of learning. *Educational Researcher, 18*(1), 32-42. https://doi.org/10.3102/0013189X018001032

Chaiklin, S. (2003). The zone of proximal development in Vygotsky's analysis of learning and instruction. In A. Kozulin, B. Gindis, V. S. Ageyev & S. M. Miller (Eds.), *Vygotsky's educational theory in cultural context* (1 ed., pp. 39- 64). Cambridge: Cambridge University Press.

Cole, M., & Wertsch, J. V. (2001). Beyond the individual-social antimony in discussions of piaget and vygotsky. Retrieved January 27, 2007, from http://webpages.charter.net/schmolze1/vygotsky/colewertsch.html

Doolittle, P. E. (1997). Vygotsky's zone of proximal development as a theoretical foundation for cooperative learning. *Journal on Excellence in College Teaching, 8*(1), 83-103.

Iding, M., Vick, R., Crosby, M., & Auernheimer, B. (2004). College students' metacognition in on-line discussions. *World Conference on Educational Multimedia, Hypermedia and Telecommunications*, 2896-2898.

John-Steiner, V., & Mahn, H. (1996). Sociocultural approaches to learning and development: A vygotskian framework. *Educational Psychologist, 31*(3), 191- 206.

Karpov, Y. (2003). Vygotsky's doctrine of scientific concepts: Its role for contemporary education. In A. Kozulin, B. Gindis, V. Ageyev & S. Miller (Eds.), *Vygotsky's educational theory in cultural context* (pp. 138-155). Cambridge: Cambridge University Press.

Kozulin, A. (2003). Psychological tools and mediated learning. In A. Kozulin, B. Gindis, V. Ageyev & S. Miller (Eds.), *Vygotsky's educational theory in cultural context* (pp. 15- 38). Cambridge: Cambridge University Press. https://doi.org/10.1017/CBO9780511840975.003

Poole, D. (2000). Student participation in a discussion-oriented online course: A case study. *Journal of Research on Computing in Education, 33*(2), 162- 177. https://doi.org/10.1080/08886504.2000.10782307

Rogoff, B. (1990). *Apprenticeship in thinking: Cognitive development in social context*. New York: Oxford University Press. https://doi.org/10.1093/oso/9780195059731.001.0001

Vygotsky, L. (1978). *Mind in society: The development of higher psychological processes*. Cambridge: Harvard University Press.

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