

Constructivism has its roots in philosophy, psychology, sociology and education. This *CDTL Brief* examines the concept of constructivism and how it contributes to teaching and learning in classrooms and IT environments.

Constructivism: What It Means for My Own Teaching

KEVIN S. CARLSON, PhD.

Educational Development Specialist, CDTL

Although constructivism has many meanings and connotations in educational literature, I will examine this concept specifically from the perspective of my academic training (as a Developmental Psychologist) in this article. In addition to my academic background, I have reached a broader understanding of constructivism from my own teaching. Consequently, some of what I write represents extensions of various theories based upon my own teaching experiences, rather than these theories in a pure form.

For this article, I will work with a simplified definition of constructivism: i.e. that learning occurs most effectively when the individual actively processes the information in a way that is meaningful to him/her, and not simply and passively incorporates information unchanged from its original form. Next, I will briefly outline two major developmental theories associated with constructivism, highlighting aspects most relevant to university education.

The first theory that I will discuss is Piaget's. Constructivism is central to Piagetian theory, in which the child acts like a little scientist—actively exploring the world, collecting data, testing hypotheses and generating principles (albeit imperfect or incorrect ones earlier in development). The major point here is the active exploring of the environment and the generation of individually-derived ways to make meaning of these observations. The individual then uses these schemas to incorporate more information; and when observations are significantly inconsonant with existing views, the schemas are modified accordingly.

It is also useful to highlight Piaget's final stage of cognitive development, formal operational thought, as it is most applicable to a university setting. Two central aspects of this stage are: (a) abstract thought able to

simultaneously evaluate alternative hypotheses, and (b) lack of egocentrism. Abstract thought refers to the fact that the individual can now think "what if" and draw logical conclusions without any actual experimentation or manipulation of objects. This development leads to more formal and logical thinking about principles and processes to predict and explain phenomenon. The ability to think "what if" requires a lack of egocentrism, the ability to think and evaluate multiple perspectives oftentimes beyond one's own previously held view. Piaget's model is useful for a university setting, with the emphasis on scientific and logical thought. While the focus for Piaget is the individual actively interacting with the physical world, the next theory adds social and interpersonal aspects to constructivism.

Socio-cultural theorists link their ideas back to the seminal work of Lev Vygotsky. Although work on the socio-cultural aspects of cognitive development really represents a larger framework more than a unified theory, some essential aspects of this perspective contrast sharply with traditional cognitive theories: traditional theories often focus on the individual, while socio-culturalists focus on the ongoing, culturally-mediated social interactions in which the individual is embedded.

This essential contrast has two important ramifications. First, the socio-cultural view highlights the importance of social processes on cognitive activity. Specifically, this perspective is interested in the bi-directional interactions between novices and experts, particularly the guidance by an expert sensitive to feedback given by the novice about the appropriate level and pace of learning. This perspective greatly differs from traditional unidirectional lecturing, where social processes are almost nil and the expert solely determines the pace and level with relatively little attention to feedback from students.

Second, by embedding the individual within socio-cultural activities, it is vital that the assessment of cognition be done in a contextualised manner. In fact, several socio-culturalists insist that cognitive abilities are only manifested in such socio-cultural activities and that believing that cognitive abilities are isolated pieces residing in one's physical brain is not useful for psychologists and educators who should focus on direct manifestations rather than indirect inferences and piecemeal measurements. Therefore, in summary, the socio-cultural perspective emphasises the rooted nature of cognitive activity within a cultural and interpersonal setting.

In my opinion, as a Developmental Psychologist and an educator, both Piagetian and socio-cultural theories have something to offer and are not mutually exclusive. Collectively, they highlight several things that university educators should consider.

1. Students learn best when actively making meaning of the material

Therefore, it is important to avoid teaching methods where we expect students to merely know what we tell them and what they read. Instead, we should seek to promote deeper thinking by having students manipulate the material in their minds, by addressing such questions as “how does this happen,” “why does this occur,” “in what circumstances does this hold,” and “are there other explanations—which explanation is better and why”.

As the socio-cultural perspective holds, the professor—as the expert—needs to guide such inquiry. One fruitful approach would be to: (a) assess what students know, (b) build upon those schemas by asking the above questions of the students (rather than giving the answers ourselves), and/or (c) challenge inaccurate naive conceptions about the world and ask students to generate and then evaluate a range of other explanations.

Constructivism does not imply hands-off teaching. On the contrary, the professor needs to be especially active in promoting these deep thinking processes in the students. As the expert, the professor can also add depth and breadth to the inquiry's content, and provide some answers concerning whether the students' speculations have been proved through empirical research (my experience is that students often derive explanations that are consonant with research findings).

Two additional points should be highlighted here:

- Students do in fact learn content with this approach. A constructivist approach, I feel, does not mean leaving students floating without answers, only promoting questioning. Instead, this approach promotes students' questioning, down

a path of logical inquiry, which then derives various explanations that are rigorously evaluated. (However, like scientists, the students realise that after this process, there are many more questions to answer and investigate.) In my experience, students going through this experience not only are exposed to the same content as if I lectured the material, but also get a value-added experience, i.e. the learning is deeper and students often bring up interesting and relevant issues that I had not considered.

- Students do not need to be “experts” to engage in deep discussions. Oftentimes I hear the belief that students need to learn a bunch of content before one can have a discussion. According to constructivism and my own teaching experience, this is definitely wrong. Students do not come into our classes as blank slates, but rather they possess various observations and beliefs about the world that we can build upon (or challenge). These pre-existing schemas are prime material for starting discussion and inquiry. It would be hard to think of any subject that we teach at NUS about which students do not have some form of ideas or opinions. When we treat our students as if they do not know anything about our subject, we rob them of the opportunities of deep learning through active inquiry.

2. Assessment should be contextualised

Of course, continuous assessments provide many opportunities for contextualisation. For example, papers, projects and experiments rooted in experiences in and observations of the world are especially useful assessments. However in NUS, even the most heavily weighted continuous assessments counts for a minority of overall marks in a course. This fact demands that we critically scrutinise our exams. Unfortunately, any casual observation of NUS students during final exam time suggests very de-contextualised assessment—when the prime mode of learning appears to be individual students staring at printouts of lecture notes given to them, seemingly in an effort to memorise all the words on the pages. I am not challenging the wisdom of giving students lecture notes (in fact, this is something that I do). My real concern is that this memorisation of lecture notes strongly suggests de-contextualised assessment. Although space limits prevents deeper exploration of this issue, open-book exams that demand such deeper learning outcomes as applying principles and processes to novel situations would help counteract mere memorisation, contextualise assessment and promote higher-order learning outcomes valued by NUS.

3. Finer attention should be paid to social processes in the classroom

Elicitation of multiple perspectives from students becomes primary. Discussions of these meanings and their subsequent evaluation and integration are essentially social processes and thrive with thoughtful facilitation by the professor. Even in a large class where all students cannot have an opportunity to speak, everyone benefits from these multiple meanings. This is because such discussions help build upon or modify one's existing schema, provide other alternatives that require thoughtful consideration, and push for integration among various perspectives—evolving more complex schema than previously held and forcing the individual student to derive criteria to

evaluate the validity of each argument (since all arguments are not equally convincing).

In conclusion, constructivism demonstrates that learning is most effective when learners actively make meaning of the material, in ways that build upon, challenge, and extend their schemas about the world. These processes can be promoted via social interactions involving such activities as being exposed to and then evaluating a variety of explanations generated by peers and being guided by an expert into deeper and more integrated modes of inquiry. As university educators, it is important that we structure our classroom activities and critically examine our assessment methods in order to promote such processes. ■

Questions and comments about this article can be sent to the author at: cdtcks@nus.edu.sg

Constructivism and IT-related Strategies: Setting the Scene

MR PAUL GAGNON, M.ED

Educational Development Specialist/Instructional Designer
Educational & Staff Development Department, Singapore Polytechnic

“*To construct or not to construct... that is the question... whether it is nobler in the mind to wait for others to model or lacking the patience thereof to venture forth and discover for one's self...*”

That ignoble introduction aside, any discussion on the use of constructivist pedagogy in an IT environment requires at the outset: (a) a clear understanding of what is meant by a constructivist pedagogy, (b) an awareness of the unique opportunities available within one's institutional IT environment—or what Jonassen (Doolittle, 1999) characterised as “the constructivist e-learning environment”, and (c) practical strategies which reflect/model the discovery approach to learning.

Constructivist Pedagogy

What then are the features of this pedagogy in an IT environment? To answer, it must first be noted that whatever one's constructivist orientation (i.e. Social, Cognitive, or Radical), there is now a general theoretical and practical consensus as to what factors must hold if learning as discovery is to take place (Doolittle, 1999). Constructivist pedagogy then requires the following:

1. presentation of an authentic and real-world environment
2. provisions for social negotiation and mediation
3. content and skills that appear to be relevant

4. prior knowledge of the learner fitting within the new content and skills to be acquired
5. formative assessment that serves to direct future learning
6. encouragement of the learner to self-regulate, self-reflect and be self-aware
7. adoption by teachers of a ‘guide on the side’ role and image as opposed to ‘the sage on stage’
8. prevalence of multiple perspectives and representations of content in every activity

The Constructivist Learning Environment (CLE)

Having assessed the extent to which one's constructivist pedagogy reflects the above factors, one must also determine to what degree one's institutional online learning environment supports constructivist meaning making. Several models have been advanced and reviewed, notably Perkins and Jonassen, to guide such assessment and are worth reading for their theoretical perspective (Seng & Heng, 2002). With respect to practical strategies and their application, however, this paper makes several assumptions with respect to current platforms¹ and their ability to support a constructivist pedagogy. Namely, does your platform:

1. allow for the uploading of support materials like cases, projects, problems and scenarios that can be used to facilitate and direct student inquiry;

2. support information resources like access to web resources, library resources and Knowledge Management databases that assist students to research, understand, respond to and solve problems;
3. provide conversation and collaboration tools like chats, forums and virtual classrooms to assist students in the sharing, exploring and refining of their understanding of content;
4. enable the formation of groups with their own access privileges, communication and presentation tools?

CLE Strategies

Given that the above conditions have been satisfied, and consistent with good classroom pedagogy, creating an online constructivist environment begins with establishing an online climate which (a) engages the learner, (b) provides a context for the type of learning that is to take place, (c) provides real world situations, and (d) outlines the support structures available to the learner throughout the his/her explorations. The examples which follow² are some suggested approaches towards utilising one's own CLE.

1. Ice-breakers

Forums can be created in which members of the class or those assigned to groups introduce themselves and provide a brief overview of their special interests in taking the course. Built into the course module could be follow-ups at mid-term and at the end of term. These new threads would require responses to guided inquiry (be it on the part of the teacher or an assigned student/s) with respect to problems encountered, new issues raised, solutions found, suggestions for further research, etc.

2. Supporting Chapters in Textbooks

This strategy involves building upon materials within assigned course textbook chapters. Here, students can be asked to submit a report on one to three content-related websites—previously researched by the instructor. Depending upon one's constructivist orientation, students can also be directed to find other sites related to upcoming chapters. Guidance for these activities could be structured as a series of questions that require them to describe and evaluate sites. For example:

- How does each site enhance understanding of the assigned chapter content?
- How might each site be improved?
- Explain why the site contributes (or does not) to the development of the assigned topic and or the discipline in general.

3. Using Case Studies

Cases, which are best conceived as short compelling descriptions related to a specific situation or set of facts, are created and placed in an online module.

Students, either individually or in groups, can be asked to generate their own questions on a specific case or respond to questions by the instructor. The questions and answers can then be featured in the synchronous or asynchronous tools (i.e. a forum, a chat room or a virtual classroom) available within the online learning environment.

4. Role-playing and Simulations

While this type of activity lends itself more readily to subject areas like human resources, business, international relations economics, history and foreign languages, creative applications can also be generated in the hard sciences. This type of activity requires careful thinking on the part of the teacher to ensure that the roles are realistic and relevant. Role-playing can be as simple as interviewer and interviewee, to as complex as responding to a country's water (or economic-political) strategy by various levels of government officials.

5. Scenarios and Asynchronous Activities

Scenarios are a means of presenting real situations and are best used in activities that require the planning of processes and procedures. Such scenarios can be used to stimulate analysis and support imaginative responses on the part of students as to how they would respond given a similar situation. Responses can be made within asynchronous discussion threads or synchronous forums like the chat room or the virtual classroom.

To conclude, a constructivist practitioner in an online environment will face many challenges, many of which ironically, will require the same characteristics of self-regulation, self-mediation and self-awareness demanded of the online learner. Perhaps most challenging of all is to remember that "technology is better used as a tool and intellectual partner that can expand the ways that learners think—not just [a means] to cram his/her head with more information" (Jonassen, 2001).

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1. Here I include all extant Course Management Delivery Systems (CMDS) or Learning Management Systems (LMS), be they Blackboard, WebCT, or of local origin.
 2. For specific details related to these examples, see Ko & Rossen (2002).

Developing Learner Autonomy Online

DR JONATHAN ALIPONGA

Hakuho Women's College/Nishiyamato School
Nara, Japan

The rise of the information age has led to the widespread use of information technology (IT) in practically all spheres of life, schools included, thereby enabling learners to further enhance and take charge of their own learning. In the past few years, many studies conducted across curricula, both qualitative and quantitative, have found that computers are being used to promote learner autonomy (Carr, *et al.*, 1998; Ingvarson & McDonald, 1997; Marcus, 1995; Volker, 1992). Those studies focus on learner-computer interaction and the resulting effects, in which the computer is programmed to anticipate the responses of the learner. However, no research has been conducted thus far on how, in particular, online language learning promotes learner autonomy through in-group and inter-group interactions.

This paper offers some suggestions on how to maximise the use of any web-based program to achieve the objective of promoting learner autonomy. These proposals are anchored on the theoretical underpinning of constructivism which emphasises the implementation of an integrated curriculum where students study a topic in various ways, and teachers use materials with which learners become actively involved through manipulation or social interaction (Bruning, 1995; Geary, 1995). In short, students are taught to be self-regulated and to take an active role in their learning by setting goals, monitoring and evaluating progress, and going beyond basic requirements by exploring interests.

Although these suggestions below are based on a study on the design, development, implementation and evaluation of online language materials in grammar (Aliponga, 2002), the insights are deemed useful across curricula. To demonstrate these ideas, particular reference will be made to Web-CT, even though there are other computer programs in the market with similar functions.

Features of Web-CT

- WebCT: WebCT is a computer program that facilitates the creation of a sophisticated web-based educational course material. Students are trained to access the WebCT page by registering online so that they can get hold of course content made up of online grammar materials, post messages and upload their group output online.

- Presentation Tool: Within WebCT is a Presentation tool that students can use to post their group output online in the form of a web page, similar to the model provided by the course content. Through creating a web page, students learn where computer pictures/graphics can be obtained and what is the appropriate choice of pictures/graphics, font size, type and background colour to be used. To post their web pages online via WebCT, students also learn uploading skills.
- Bulletin/Discussion Tool: WebCT also includes a Bulletin tool which students can use to write and post comments concerning the output of other groups. Through the Bulletin tool which maximises student interaction beyond a one-hour classroom meeting, students learn how to critique the efforts of other groups as well as where, when and how to post these comments.

Developing materials to promote collaborative learning

Olsen & Kagan (1992) pointed out that not all types of learning tasks are necessarily cooperative. For a task to achieve cooperation among students, it must be designed and developed in such a way that it would be better done by a group, rather than by an individual, and that each group member should depend on the others for some aspect of the task. Learning materials must be carefully developed and distributed so as to convey to students that the work on the task should be a joint, and not individual, effort and that they are in a "sink or swim together" situation (Johnson, Johnson, Holubec & Roy, 1984).

Consequently, it is suggested that online learning materials need not be limited only to text-based tutorials and drill-and-practice activities. Such materials can be developed to accommodate, for instance, grammar problem-solving tasks, as setting problem-solving or situational tasks can help to promote cooperative learning. By working in groups of two or three to create and upload a web page that contains the tasks similar to an existing online model web page, students are provided with the opportunities to learn from one another and ask individual questions so as to possess their learning; in this way, they become more responsible for their own learning and the learning of others (Brown, 2001; Kessler, 1992).

Using the Bulletin tool to promote critical thinking

Goldberg (1997), in his study, claims that a course containing an online discussion tool can promote critical thinking in two ways. First, a student who makes comments thinks critically because he analyses the work of others based on a given criteria. Second, group members also employ critical thinking because the comments challenge them to assess their work: they are compelled to think and discuss among themselves to find out if each comment is true. Especially in the field of language learning, such a discussion process helps students to sort out their thinking, interpret and reflect on experiences, exercise their imagination, and develop their skills for continued autonomous learning, thereby allowing them to gain confidence in their ability to analyse the data available in the language to which they have access.

Conclusion

Creating online instructional materials along constructivist principles provides an important and sound theoretical framework with which to promote learner autonomy. Problem-solving or situational tasks are incorporated within the materials in the form of a web page posted via the Presentation tool. Interaction through the WebCT Bulletin tool is facilitated among students (and between students and instructor) in such a manner as to bring about more student involvement and greater control on their part over their learning as well as provide more opportunities for them to work collaboratively.

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Jonathan Aliponga is currently affiliated with Hakuho Women's College and Nishiyamato School in Nara, Japan, teaching English I and Speech English, and English conversation, respectively. He holds a doctorate degree in applied linguistics. His interest is on CALL.



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contributors

Kevin S. Carlson
Paul Gagnon
Jonathan Aliponga

advisor

Daphne Pan

editors

Verena Tay
Teo Siok Tuan

layout

Ma Lin Lin

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Comments, suggestions and contributions should be addressed to:

The Editor, *CDTL Brief*
Centre for Development of Teaching and Learning
Central Library Annexe, Level 6
National University of Singapore
10 Kent Ridge Crescent
Singapore 119260

Tel: (65) 6874-3052
Fax: (65) 6777-0342
Email: cdtpost@nus.edu.sg
<http://www.cdtl.nus.edu.sg>

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