Generative Learning Objects for Collaborative Learning and Critical Thinking: A Proposed Conceptual Framework

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Abstract

The paper reports on a proposed conceptual framework for the design of an online learning system that uses the dynamic attributes of learning objects in the design approach of learning contents. Their role in generative learning in the design of a learning strategy that fosters and promotes critical thinking is also delineated. The proposed system is centred on knowledge construction via the design of learning objects (LOs) by the students and uploading them into the system called the Learning Object Repository (LOR). The system also focuses on the collaborative learning strategy that provides an environment to scaffold the learning process that facilitates students' reflection and involvement of critical thinking processes. The proposed conceptual framework provides the development of a system that is dynamic and conducive for collaborative interaction utilising the collaborative LO library, the content organiser, a reflection and forum/chat activity template as well as learning assessment tools.

Abstrak

Artikel ini melaporkan cadangan rangka kerja konsep untuk reka bentuk suatu sistem e-pembelajaran yang menggunakan atribut dinamik objek pembelajaran dalam pendekatan mereka bentuk bahan pembelajaran. Peranannya dalam pembelajaran generatif dalam mereka bentuk strategi pembelajaran yang menggalakkan

permikiran kritis juga dibincangkan. Sistem yang dicadangkan berpusat kepada pembinaan pengetahuan melalui reka bentuk objek pembelajaran oleh pelajar dan memuatnaikkannya ke dalam sistem yang dipanggil Repositori Objek Pembelajaran. Sistem ini juga berfokus kepada strategi kolaborasi yang menyediakan suatu persekitaran untuk membimbing proses pembelajaran yang menggalakkan refleksi pelajar dan penglibatan pelajar dalam proses pemikiran kritis. Cadangan rangka kerja konsep ini menyediakan pembangunan sistem yang dinamik dan kondusif interaksi kolaboratif menggunakan perpustakaan objek pembelajaran, pengatur isi kandungan, templat aktiviti refleksi, chat dan forum serta alat penilaian pembelajaran.

Introduction

The development of the World Wide Web (www) has revolutionised teaching and learning methods. Face-to-face teaching is no longer the only way that facilitates teaching and learning. The transformation in teaching and learning is gradually taking place especially with the potential of the distributed learning and universal educational resource delivery via the www. The www platform provides an opportunity for collaborative and distance learning, but requires appropriate adoption of learning theories and technologies.

Life in the 21st century requires people to face various challenges and changes. However, for many years, contemporary education has been giving more focus on face-to-face learning and individual learning. The impact of information and communication technologies (ICT) on our daily activities has immersed learners in digital lifestyles. They can learn anytime and at any place with the ICT devices. Therefore, they should be equipped with collaborative and critical thinking skills. It was further pointed out by Lakkala (2007) that learners should be equipped with transferable skills that are required at any workplace that is dynamic and technology driven.

Society expects graduates to possess not only knowledge but also skills required at the global workplace. Concern has been raised that students in school will fail to meet the requirements of the global economy because they are unable to think and work in teams (Wallis & Steptoe, 2006).

Today's education should focus on the development of learners' competences and skills for the 21st century society rather than the mere development of subject content mastery (Lakkala, 2007). Seen in this light, the education system today should involve learners in a collaborative learning environment and a learning process that requires them to construct their understanding meaningfully, utilising critical thinking.

The large amount of information on the internet has outstripped our abilities to process and use the information. We are not only required to receive such a large amount of information, but also need to build on what is received. This requires critical thinking (MacKnight, 2000). We must be able to analyse, synthesise and evaluate the information received. It is increasingly important for students to have critical thinking in order to process such information.

Critical thinking is a common objective of various disciplines (MacKnight, 2000). It is one of the important skills required by the workplace in the 21st century. The advancement of technology in this century has put an increased emphasis on teamwork and effective communication skills. People need to work, solve problems and make decisions as a team. Therefore, critical thinking is very important and it can be fostered through collaborative learning (Gokhale, 1995). Critical thinking is defined as thinking that contains elements such as analysis, synthesis and evaluation (Gokhale, 1995; Lewittes, 2007). Critical thinking works closely with the activities emerging from collaborative learning (MacKnight, 2000; Gokhale, 1995; Lewittes, 2007). Learners engage in critical thinking through collaborative tasks such as discussing the activities of searching and sharing, elaborating on knowledge and constructing arguments and knowledge together.

Collaborative learning is defined by Gokhale (1995) as *"...an instruction method in which students at various performance levels work together in small groups toward a common goal..."* (pp. 22). Lakkala (2007) further pointed out that students are active agents who share ideas, solve problems, use various information sources and create knowledge together in collaborative learning. In collaborative activities, each member in a group is contributing to the success of the entire group. All the members in the group work together to accomplish shared learning goals.

Collaborative learning has been integrated as part of the learning design in most of the online distance learning achieved through the use of forums and chats. A study by Curtis and Lawson (2001) showed the presence of effective collaboration in online distance learning. Learners can learn through collaborative online learning without face-to-face learning. Hiltz (1998) demonstrated that collaborative learning can bring about learning outcomes as effective as with those achieved in face-to-face learning.

Findings from research support the view that social skills and competencies, such as leadership, communication skills and critical thinking, tend to increase through collaborative learning. Slavin (1996) showed that when students work in teams, they engage in active learning which requires them to use critical thinking. Gokhale (1995) further pointed out that collaborative learning fosters the development of critical thinking. Johnson and Johnson (1989) highlighted that collaborative learning increases students' abilities in leadership and effective communication as well as enable them to manage conflicts constructively. The effectiveness of collaborative learning with the use of technology has been confirmed by various studies. For instance, students' involvement and critical thinking as well as understanding of subject matter have been known to increase significantly through online collaborative learning (Curtis & Lawson, 2001).

Nowadays, most instructional designers understand the importance of pedagogical perspectives in the design and development of web-learning environments. The concept of a one-size-fits-all design learning system is no longer suitable especially for web-based teaching and learning. The learning environment should be highly flexible in structure to promote collaborative learning and critical thinking. Therefore, the concept of a design using learning objects fits in very well as it provides flexible paths to users' exploration that involves them in critical thinking. The non-linearity of the learning object design allows students to access information in different patterns, learning by constructing and collaborative learning. Such a learning environment engages learners in critical thinking and self-paced learning.

Using learning objects (LOs) leads to the design of instructions into small learning contents that can be reused in different contexts and can be

combined to form learning that is appropriate to the individual (Wiley, 2000; Hodgins, 2001; Wagner, 2002; Mills, 2002; Hanaffin et al., 2000; South & Monson, 2000; Collis & Strijker, 2003). It is a current trend in computer-based instruction and learning that is grounded in the object-oriented paradigm of computer science.

The idea of information in small chunks which are reusable and flexible in a learning environment has received a great amount of attention from educators and instructional designers of the e-learning environment. According to Reigeluth and Nelson (1997), when teachers first gain access to instructional materials, they often break the materials down into their constituting parts and then reassemble these parts in ways that support their instructional goals. Thus, small and reusable units of learning contents, learning components and learning object designs have the potential of providing flexibility and reusability by simplifying the assembly and disassembly of instructional design and development (Tan, 2006). Lakkala (2007) highlighted that the dynamic attributes of LOs enable them to be very effective in collaborative learning. Digital content materials which are designed in the form of LOs can be used by learners to search and define learning contents collaboratively.

The presence of LOs enhances the flexible, reusable and generative learning environment by allowing learners to participate actively in the construction of knowledge as well as being involved in critical thinking. From the theoretical perspective of generative learning, the LO design can be configured within generative learning environments (Bannan-Ritland et al., 2000). This is further demonstrated by the development of Generative Object Oriented-based Design (GOOD) Learning System by Tan et al. (2006). The attributes of LOs are illustrated in the generative learning of the system. It is evident that the dynamic attributes and nature of LOs match well with generative learning.

Generative learning is conceived under the cognitive information processing proposed by Wittrock (1974). The focus of the generative learning model is that the learner is an active participant who works to construct meaningful understanding by generating relationships between the different types of information he/she receives. Cognitive psychologists and educationists usually see these as the skills associated with thinking

activities. These activities are completely in contrast to those which simply involve the memorising of information where the students passively receive information with or without processing the information meaningfully.

Building on such studies and views as discussed above, this paper proposed a conceptual model for the design and development of an online learning system that uses LOs in the design approach of learning content, resulting in generative learning in the design of learning strategy that assists collaborative learning as well as fosters critical thinking. This model incorporates four important components, namely, the learning object, generative learning, collaborative learning and critical thinking in a technologically-supported learning environment. The model aimed to facilitate the students to engage in critical thinking, using collaborative skills. A comprehensive study was conducted in this project to evaluate the effectiveness of the proposed model.

Objectives

The main objective of this paper was to develop a conceptual framework for the design of the online learning system that uses LOs in the design approach of the learning content and adopts generative learning in the design of the learning strategy. It was hoped that the system developed based on the proposed conceptual framework would centre on the collaborative learning strategy and foster critical thinking.

The Theoretical Framework

The theoretical framework of the proposed conceptual framework incorporated a few important components from different perspectives. LOs were adapted for the instructional design structure, while the pedagogical perspective, the generative learning and collaborative learning model were modified from Reid et al. (1989); elements of critical thinking were also incorporated into the design of the online learning system. The web was used as a delivery medium for the system. All these aspects had been studied in detail in order to meet the objectives of this research.

The pedagogical design of the proposed online learning system was based on generative learning from constructivism learning from Bonn & Grabowski (2001), Grabowski (1996) and Dunlap & Grabinger (1996a; 1996b), LOs and generative learning from Bannan-Ritland et al. (2000) and Tan et al. (2006) and collaborative learning from Reid et al. (1989). The features of the learning included the following:

• Provide a learning environment that enables the collaborative process of knowledge construction and sharing.
• Provide a learning environment that supports the construction of knowledge collaboratively.
• Learners are active participants and partners in constructing their knowledge.
• Learners are able to interpret their learning and build their mental model collaboratively and individually to represent their knowledge.
• Learners are required to construct knowledge collaboratively through learning aids such as the contents organiser that engages them in critical thinking.

From the description above, it is apparent that the learning environment that contains generative learning, collaborative learning and learning objects requires learners to analyse, synthesise and evaluate facts and ideas in the process of knowledge construction. The critical thinking elements used in the proposed system are analysis, synthesis and evaluation as suggested by (Lewittes, 2007).

Collaborative learning represents a significant shift away from teacher-centred learning to student-centred learning. The strategy of the collaborative learning in this project is based on the collaborative learning model from Reid et al. (1989). According to them, there are five phases in the designing of instruction for collaborative learning.

Phase I: Engagement
The design of learning should provide collaborative activities/tasks that are designed to ensure group activities and ownerships.

Phase II: Exploration

In this phase, learners work on the initial exploration of ideas and information. Some inputs will be given and the rest will be left to the resourcefulness of the learners. Reflection that contains questions (KWHLS) can be used for learners of all ages and levels to help ensure that every learner pursues goals that are individually beneficial and yet congruent with the group's common goals in learning activities.

- K: What do I know?
- W: What do I want to learn?
- H: How will I learn it and work with others to attain mutual goals?
- L: What have I learned?
- S: How have I shared or will share when I learn from others?

Phase III: Transformation

In this phase, learners and their groups engage in activities to transform information by organising, clarifying, elaborating or synthesising learning concepts. It is important at this stage of learning that tasks entail discussion and contribution from all group members.

Phase IV: Presentation

In this phase, learners are required to prepare presentations of their work. They will receive feedback from peer or expert groups.

Phase V: Reflection

Learners analyse what they have learned, identify strengths and weaknesses in the learning processes they have gone through and offer constructive ideas on how their learning can be improved. The reflection will be done both individually and collaboratively. Learners need to analyse individual as well as group learning processes. Examples of questions are the following:

- To prepare this activity, I...
- I think I contributed to the group's work quality by…
- Something that would help us work better next time is…
- One thing that was not useful to our group was…
- Some ways in which the thinking of the group could have been better are…

According to Ip & Morrison (2001), learning objects have the potential of being integrated into different learning paradigms. This is further elaborated by Bannan-Ritland et al. (2000) who clearly showed that the features of learning objects support flexibility and reusability is aligned and heavily related to generative learning from constructivistic learning (Bannan-Ritland et al., 2000), collaborative learning and critical thinking.
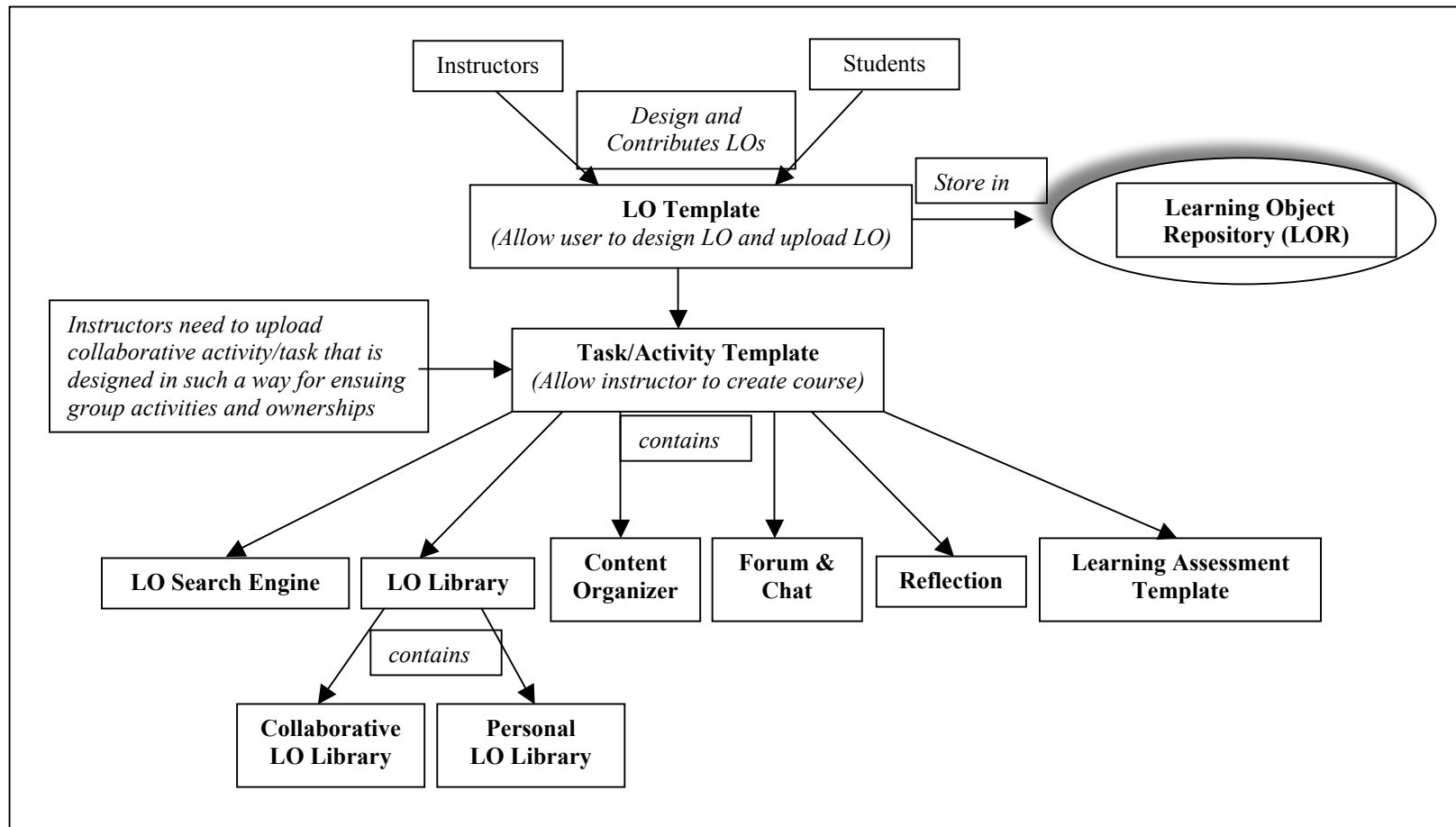
Figure 1 depicts the theoretical framework demonstrating the incorporation of generative learning, LOs, collaborative learning and critical thinking in this project.
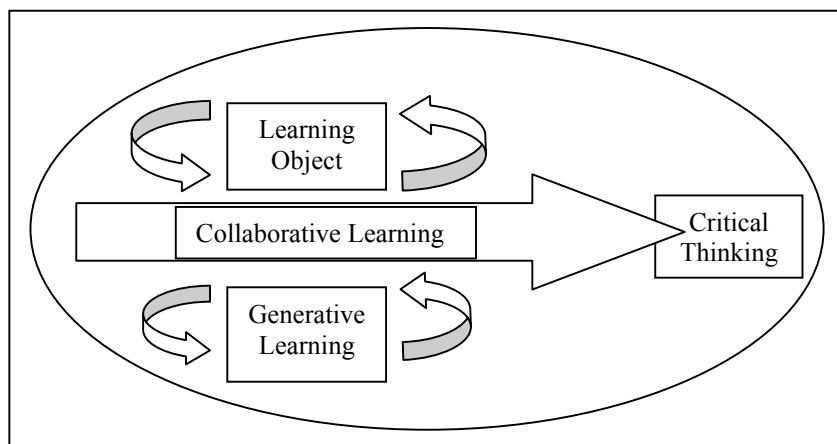
Figure 1   Theoretical Framework

The Conceptual Framework

Based on the theoretical framework depicted in Figure 1, a conceptual model of a web-based learning system is proposed in the design of the learning environment in the system development. See Figure 2.

Figure 2   The Proposed Conceptual Model of the System based on the Theoretical Framework

The proposed model is based on the attributes mentioned in the theoretical framework. Its design is based on the dynamic attributes of LOs that match well with generative learning and collaborative learning. The model is not only a knowledge construction tool but is also a mind tool that involves and promotes critical thinking. The following points describe the prominent properties of the conceptual model:

- It is a knowledge base that contains chunks of learning (LOs) and allows linking between the LOs as designed in the Learning Object Repository (LOR).
- It contains a knowledge domain which is broken into small parts (LOs) that are flexible, reusable and stored in the LOR.
- It provides an environment in which the LOs can be designed based on the Learning Object Template (LOT); these objects can be uploaded and contribute to the LOR in the system.
- It enables instructors to initiate learning through the design of the Task/Activity Template.
- It provides a collaborative learning environment for collaboratively knowledge construction in the Collaborative LO Library and the Content Organiser.
- It provides a learning environment which can be controlled, assessed and directed by the students as designed in the Collaborative LO Library and Content Organiser, Learning Assessment and Reflection.
- It provides an environment for concept construction as designed in the Collaborative LO Library, Content Organiser and Learning Assessment.
- It provides an environment to scaffold a learning process that facilitates students' reflection and involvement of critical thinking as designed in Reflection.
- It provides a dynamic environment that is conducive for collaborative interaction as designed in the Collaborative LO Library, Content Organiser, Reflection and Forums and Chats.

Conclusion

Numerous e-learning systems have been developed with the objective of promoting learning through the use of ICT. However, questions arise on

how learning objectives can be achieved and learners' collaborative and thinking skills promoted. The reusability and flexibility of LOs could be encouraged to promote learning which incorporates pedagogical aspects such as generative and collaborative learning. The proposed conceptual model therefore provides a basis for the design and development of a web-based system to promote critical thinking through generative and collaborative learning with the use of the LOs. We are in the process of developing such a system which can be shared; it is then hoped that the ensuing experience and evaluation of using such as system can be recorded in a subsequent paper.

References

Bannan-Ritland, B., Dabbagh, N. & Murphy, K. (2000). Learning object systems as constructivist learning environments: Related assumptions, theories and application. In Wiley, D.A. (Ed.). *The Instructional Use of Learning Objects:* http://reusability.org/read/.

Bonn, K.L. & Grabowski, B.L. (2001). Generative learning theory: A practical cousin to constructivism. Paper Presented at the Joint Meeting of Mathematics. New Orleans, LA.

Collis, B. & Strijker, A. (2003). Re-usable learning objects in context. *International Journal on E-Learning*, *2*(4), pp. 5−17.

Curtis, D.D. & Lawson, M.J. (2001). Exploring collaborative online learning. *JALN, 5*(1), pp. 21−34.

Dunlap, J.C. & Grabinger, R.S. (1996a). Rich environment for active learning in the higher education classroom. In Wilson, B.G. (Ed.) *Constructivist Learning Environments: Case Studies in Instructional Design*. NJ: Educational Technology, pp. 65−82.

Dunlap, J.C. & Grabinger, S. (1996b). Make learning meaningful. In Kommers, P.A.M., Grabinger, S. & Dunlap, J.C. *Hypermedia Learning Environments: Instructional Design and Integration*. New Jersey: Lawrence Erlbaum Association. pp. 227−254.

Gokhale, A.A. (1995). Collaborative learning enhances critical thinking. *Journal of Technology Education*, 7(1), pp. 22−30.

Grabowski, B.L. (1996). Generative learning: Past, present, and future. In Jonassen, D.H. (Ed). *Handbook of Research for Educational Communication and Technology*. NY: Simon and Schuster Macmillan. pp. 897−918.

Hannafin, M.J., Hill, J.R. & McCarthy, J.E. (2000). Designing resource-based learning and performance support systems. In Wiley, D.A. (Ed). *The Instructional Use of Learning Objects*. http://reusability.org/read/chapters/hannafin.doc.

Hiltz, S.R. (1998). Collaborative learning in asynchronous learning networks: Building learning communities. WEB98, Orlando Florida, November. http://eies.njit.edu/~hiltz/collaborative_learning_in_asynch.htm

Hodgins, H.W. (2001). The future of learning objects. In Wiley, D.A. (Ed). *The Instructional Use of Learning Objects: Online Version*. http://reusability.org/read/chapters/gibbons.doc.

Ip, A. & Morrison, I. (2001). Learning objects in different pedagogical paradigms. *The Proceedings of the ASCILITE 2001*. pp. 289–298. http://www.medfac.unimelb.edu.au/ascilite2001/pdf/papers

Johnson, D.W. & Johnson, R.T. (1989). *Cooperation and Competition: Theory and Research*. Edina, MN: Interaction Book Company.

Lakkala, M. (2007). The Pedagogical Design of Technology Enhanced Collaborative Learning. http://www.elearningeuropa.info/files/media/3028.pdf.

Lewittes, H. (2007). Collaborative learning for critical thinking: Pedagogy, learning outcomes and assessment, Retrieved from http://www.aacu.org/meetings/generaleducation/documents/Lewittes.pdf.

MacKnight, C.B. (2000). Teaching critical thinking through online discussions. *Educause Quarterly*, *4*, pp. 38–41.

Mills, S. (2002). *Learning About Learning Objects With Learning Objects*. http://www.alivetek.com/learningobjects/site_paper.htm.

Reid, J., Forrestal, P. & Cook, J. (1989). *Small Group Learning in the Classroom*. Portsmouth, NH: Heineman.

Reigeluth, C.M. & Nelson, L.M. (1997). A new paradigm of ISD? In Branch, R.C. & Minor, B.B. (Eds). *Educational Media and Technology Yearbook*. Englewood: Libraries Unlimited. *22*, pp. 24–35.

Slavin, R.E. (1996). Research on cooperative learning and achievement: What we know, what we need to know. *Contemporary Educational Psychology*, *21*, pp. 43–69.

South, J.B. & Monson, D.W. (2000). A university-wide system for creating, capturing, and delivering learning objects. In Wiley, D.A. (Ed). *The Instructional Use of Learning Objects*. http://reusability.org/read/

Tan, W.C. (2006). *Development and Evaluation of A Web-Based Learning System Based on Learning Object Design and Generative Learning to Improve Higher-Order Thinking Skills and Learning*. Unpublished doctoral dissertation, Universiti Teknologi Malaysia, Malaysia.

Wallis, C. & Steptoe, S. (2006). How to build a student for the 21st century. *Time Magazine*, December 18.

Wagner, E.D. (2002.) The new frontier of learning object design. *The eLearning Developers' Journal*. http://www.wlearningguild.com/pdf/2/061802DST-H.pdf.

Wiley, D.A. (2000). *Learning Object Design and Sequencing Theory*. Brigham Young University: Doctor of Philosophy Thesis. Unpublished.

Wittrock, M.C. (1974). Learning as a generative process. *Educational Psychologist*. *11*(2), pp. 87–95.