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Meaningful interaction in web-based learning: A social constructivist interpretation

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Abstract

Interaction is an essential ingredient in any learning process. However, every interaction does not lead to increased learning. When interaction has a direct influence on learners' intellectual growth, we can say the interaction is meaningful. The precise meaning of meaningful interaction is strongly related to the learning theories underlying the development of particular learning environments. The primary goal of this paper is to re-conceptualize online interaction in terms of meaningful learning based on the learning theory known as social constructivism. Analyzing interaction through this theoretical framework may yield design principles needed to improve the quality of Web-based learning environments. A secondary goal of this paper is to present the implications of meaningful online interaction for researchers and developers.

Keywords: Online interaction; Meaningful interaction; Social constructivism; Authentic task; Web-based learning environment

1. Introduction

Instructional Technology is a design field in which people endeavor to increase the effectiveness of instruction and learning through the integration of pedagogy and technology. Instructional designers are practitioners within this design field. One of the key components of good pedagogy, regardless of whether technology is involved, is interaction. Interaction is an essential ingredient of any learning environment (face-to-face classroom-based, synchronous/asynchronous online education, or blended models). Interaction in learning is a necessary and fundamental process for knowledge acquisition and the development of both cognitive and physical skills (Barker, 1994). Thus, increasing interaction and enhancing its quality have long been important research goals for Instructional Technology researchers and instructional designers (Hannafin, 1989). Instructional designers believe the opportunities for and quality of interaction in support of learning can be improved by technology, a belief that has grown with the development of the Internet.

In Web-based learning environments, maintaining interaction is more challenging than in face-to-face learning contexts because of the time and space separation enabled by the technology (Angeli, Valanides, & Bonk, 2003;

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Bannan-Ritland, 2002). In the context of Web-based learning environments, researchers and designers (who are sometimes the same people) have shifted their focus from learner–content interaction to learner–learner interaction as well as from the quantity of interaction to its quality (Deubel, 2003; Moallem, 2003; Vrasidas, 2000). Despite advances, more and better research aimed at improving the learning effectiveness of online interaction is needed.

Unfortunately, instructional designers still lack sound theoretical foundations for determining what is good quality or meaningful interaction. Design guidelines for interaction in online learning are more akin to heuristics than to research-based principles. To provide a starting point for improving this situation, we will argue in this paper that interaction in Web-based learning should be re-conceptualized based on the learning theory known as social constructivism (Gergen, 1999). We will start with a brief review of the definitions and types of online interaction.

2. Defining online interaction

The nature of interaction in various forms of learning environments has been defined in a variety of ways, based upon the participants' level of involvement in a specific learning opportunity such as a university course or a corporate training program and the objects of interaction such as other participants or content materials. The nature of interaction is also dependent upon the contexts in which interaction occurs, in a face-to-face situation or at a distance.

Moore's (1989) classic definition of interaction within distance education is based upon a communication-based framework, defining the sender and receiver of three types of interaction: learner-content, learner-instructor, and learner–learner. Also within the context of distance education, Wagner (1994) defined interaction as "the reciprocal events that require at least two objects and two actions" (p.8). Such interactions are said to occur when these two objects and events reciprocally influence each other. Hillman, Willis, and Gunawardena (1994) insisted that these and other past discussions of interaction overlooked the fact that all interaction is mediated via a medium in technology-based learning situations. On the basis of their research, Hillman et al. added a fourth kind of interaction, learner-interface interaction to Moore's three types of interaction. More controversially, Sutton (2001) defined a fifth type of interaction, vicarious interaction, which "takes place when a student actively observes and processes both sides of a direct interaction between two other students or between another student and the instructor" (p. 227). Whether such "self-talking" or internal discourse interaction should be categorized with other forms of more directly observable interaction is debatable. Northrup (2001) proposed five interaction purposes: to interact with content, to collaborate, to converse, to help monitor and regulate learning (intrapersonal interaction), and to support performance.

Taking into account the previous definitions, Muirhead and Juwah (2004) described interaction as "a dialogue or discourse or event between two or more participants and objects which occurs synchronously and/or asynchronously mediated by response or feedback and interfaced by technology" (p.13). According to them, interaction serves a wide range of functions in the learning process: promoting active learning, enabling effective facilitation, allowing learner input in the learning process, enabling the development of higher order knowledge and abilities, and enhancing the quality and standards of the learning experiences.

3. The meaning of meaningful

Of course, every interaction in a Web-based learning environment does not have an influence on increased learning. Idle chatting, online surfing, or mindlessly clicking Web pages is unlikely to lead to substantive learning even though learners are interacting with other objects. In this context, Vrasidas and McIsaac (1999) focused on not just interaction but meaningful interaction. Hirumi (2002) also mentioned meaningful interaction emphasizing the quality of interaction on learning. Meaningful interaction is not just sharing personal opinions. Instead, the interaction must stimulate the learners' intellectual curiosity, engage them in productive instructional activities, and directly influence their learning (Hirumi, 2002; Vrasidas & McIsaac, 1999).

Depending on how learning is defined, the image of meaningful interaction is changed (Deubel, 2003; Hannafin, 1989; Vrasidas, 2000). That is, the meaning of meaningful interaction is strongly related to the learning theories underlying the development of particular learning environments. For example, in the behaviorist learning theory called operant conditioning (Skinner, 1954); learning is defined as a change in observable behavior. If the interactions in a

learning environment primarily involve exposure to a stimulus (e.g., a multiple-choice question in a computer-based drill-and-practice program) and a learner response (e.g., selecting the correct response from the multiple choices) followed by reinforcement (e.g., a smiley face appearing on the screen and an audio clip saying "You are correct."), then the interactions are meaningful within the principles of that learning theory and within the context of the computer-based program that has been designed according to the theory of operant conditioning (Deubel, 2003; Hannafin, 1989). Within the behaviorist model, learners are viewed as somewhat passive, in need of external motivation, and directly affected by reinforcement (Skinner, 1954). Much of the research on interaction strategies has also emphasized behaviorist functions of the interaction between learner and content as mediated on a computer screen such as confirmation, pacing, and navigation (Burton, Moore, & Magliaro, 2004; Hannafin, 1989).

In an effort to increase meaningful interaction, instructional technology researchers and designers working from a communications or media theory framework (Krendl, Ware, Reid, & Warren, 1996) have studied the format in which content is presented to students in order to increase interaction with content (Moallem, 2003). One example of this kind of inquiry is message design research (Stemler, 1997) that has sought to identify the characteristics of visual, auditory, and multi-channel communications that enhance learning (Anglin, Vaez, & Cunningham, 2004; Barron, 2004; Moore, Burton, & Myers, 2004).

From a systems theory approach (Banathy & Jenlink, 2004); much research has been conducted in applying instructional design principles to the development of more effective online learning environments (Moallem, 2003). For example, the Instructional Technology Resource Center at Idaho State University (2002) developed the WebCT Ordinal Web Delivery Organization Companion (WOWDOC) to aid faculty to develop interactive online courses. The structure of the WOWDOC is based on the outline of instructional strategies offered in the Dick, Carey, and Carey (2001) instructional design model (see http://www.isu.edu/itrc/resources/webct/wowdoc.pdf).

Another perspective on the meaning of interaction comes from cognitive learning theories such as information processing theory (Winn, 2004). For example, Kirschner, Sweller, and Clark (2006) maintain that "The aim of all instruction is to alter long-term memory. If nothing has been changed in long-term memory, nothing has been learned" (p. 77). From what to some may seem to be an over-simplified perspective, learning is primarily about fostering the interaction between working memory and long term memory, most, often via what they call "direct instruction" (Klahr & Nigam, 2004).

Most researchers and practitioners do not work within only one framework. For example, Stemler (1997), on the basis of various theories such as Gagne's nine events of instruction, Keller's ARCS motivation model, human computer interaction theory, and message design theory, provided several suggestions for screen design in order to increase interaction quality:

- provide key information in prominent locations with critical information at the beginning of a message;
- place questions and important messages in the middle of the screen;
- use highlighting to focus attention;
- include orientation cues to assist in navigation;
- use universal icons that are familiar to learners.

Research and development based on behavioral, communications, systems, and cognitive theories still comprise a major part of online interaction research. These lines of research have contributed to the development of relatively simple heuristics, guidelines, and tips for designing Web-based learning environments. Winn (2002), among others, has criticized the oversimplification of the complexity of interaction. Critics point out that Web-based learning programs that are limited to learner-content interactions based on behaviorism rely too heavily on self-instructional text, failing to promote human-to-human interaction among students and instructors (Hirumi & Bermudez, 1996).

Since the 1990's, constructivism has exerted a strong influence on education in general and the Instructional Technology field in particular. Although there are many variants of constructivist learning theory (Fosnot, 1996), they share a perspective that learning is defined as meaning making. In other words, according to constructivists, learning requires the personal interpretation of phenomenon such as the construction of a mental model representing complex phenomenon. Therefore, when interactions in a learning environment are designed to enhance meaning making, then those interactions are meaningful within the principles of the constructivist learning theory and within context of interactive learning environments that have been designed according to the theory of constructivism (Gergen, 1999).

Constructivism has provided different forms of theoretical bases for effective online learning environments as well as for face-to-face classroom learning environments (Jonassen, 1999; Jonassen, Davidson, Collins, Campbell, & Haag, 1995). Constructivism is a theory about knowledge and learning. It describes both what "knowing" is and how one "comes to know." (Fosnot, 2005, p. ix). Constructivism rests on the assumption that knowledge is constructed by learners as they attempt to make sense of their experiences (Driscoll, 2000). Knowledge is a function of how the individual creates meaning from his or her experiences (Jonassen et al., 1995). That is, knowledge does not consist of objective truths to be transmitted via media, but formative, developmental, and constructed explanations by humans engaged in meaning-making process (Driscoll, 2000; Fosnot, 1996, 2005; Jonassen et al., 1995; Vrasidas, 2000). Clearly, learning from the constructivist perspective is a human meaning-making venture (Driscoll, 2000; Fosnot, 1996, 2005; Gergen, 1999; Jonassen et al., 1995; Vrasidas, 2000). However, there are various explanations on how we come to engage in meaning-making.

Constructivism was greatly influenced by the later work of Jean Piaget and the socio-historical work of Lev Vygotsky (Fosnot, 1996; Gergen, 1999). Piaget believed that in a cognitive sense, the human is also a developing organism just like in a physical and biological sense. He proposed that the mechanism promoting change in cognition is equilibration. Equilibration is described as a dynamic process of self-regulated behavior balancing two intrinsic extreme behaviors, assimilation and accommodation (Fosnot, 1996). According to Piaget's explanations, meaning making is a process of attaining 'equilibration' through thoughtful engagement in assimilation and accommodation; this is a process that occurs primarily at the individual cognitive level (Driscoll, 2000; Fosnot & Perry, 2005; Von Glaserfeld, 1996). Thus, we call his theory cognitive constructivism.

Vygotsky, on the other hand, was more focused on the effects of social interaction, language, and culture on learning (Fosnot & Perry, 2005; Jonassen et al., 1995; Vrasidas, 2000). Vygotsky emphasized dialogue. He argued that all cognitive functions originate in social interactions and that learning is not simply the assimilation and accommodation of new knowledge by learners; it is the process by which learners are integrated into a knowledge community (Fosnot & Perry, 2005; Jonassen, 1999; Jonassen et al., 1995; Lave & Wenger, 1991; Vrasidas, 2000; Vygotsky, 1978). Vygotsky was interested 'not only in the role of inner speech on the learning of concepts but also on the role of the adult and the learners' peers as they conversed, questioned, explained, and negotiated meaning' (Fosnot, 1996, p, 20). In his perspective, meaning making is the process of sharing various perspectives and experiences in communities of practice (Fosnot, 1996; Fosnot & Perry, 2005; Jonassen et al., 1995; Lave & Wenger, 1991; Vrasidas, 2000; Vygotsky, 1978). Therefore, learning is derived from rich conversation with other people who have similar or different perspectives based on their own life experiences (Jonassen, 1999; Jonassen et al., 1995). We call this theory social constructivism.

4. Rethinking interaction from a social constructivist perspective

Humans are social beings; we grow up through the social interactions in various communities. Recently, many educators have come to see the value of social constructivism as a foundation for the design of more effective learning environments. Social constructivists regard individual subjects and the social society as interconnected. Social constructivists assert that learners arrive at what they know mainly through participating in the social practices of a learning environment including collaborative projects and group assignments as well as in the social practices of the local communities including family life and church events (Stage, Muller, Kinzie, & Simmons, 1998). Learning is viewed primarily as a social product yielded by the processes of conversation, discussion and negotiation (Confrey, 1995; Ernest, 1995). In addition, social constructivists lay stress on the role of the adult and the learners' peers as they converse and negotiate meaning (Fosnot, 1996). Social constructivists argue that students can, with help from adults or peers who are more advanced in their meaning-making, begin to grasp concepts and ideas that they cannot understand on their own. However, social constructivists do not maintain that all conversation and discussion occurring anywhere anytime are meaningful for learning. They also emphasize that learning and thinking are situated in social contexts. One important social constructivist notion consists of authentic or situated learning, where the student takes part in activities which are directly relevant to his/her real life and which take place within a culture similar to an applied setting (Brown, Collins, & Duguid, 1989).

Social constructivism explains the foundational processes of learning using three concepts: 1) the 'Zone of Proximal Development (ZPD)', 2) 'Intersubjectivity,' and 3) 'Enculturation' (Fosnot, 1996; Fosnot & Perry, 2005; Jonassen, 1999; Jonassen et al., 1995; Lave & Wenger, 1991; Vrasidas, 2000; Vygotsky, 1978). The Zone of Proximal

Table 1
The characteristics and applications of social constructivism (Jaworski, 1994; Ernest, 1995)

Characteristics	–Active construction of knowledge based on experience with and previous knowledge of the physical and social worlds
	–Emphasis on the need for the ZPD
	–Emphasis on the influence of human culture and the sociocultural context
	–Recognition of the social construction of knowledge through dialogue and negotiation
	–Emphasis on the intersubjective construction of knowledge
	–Multiple interpretations of knowledge
Applications	–Emphasis on the critical role of peers, in particular more skilled students
	–Enculturation of students into the community of the particular academic discipline or profession
	–Use of relevant and authentic tasks
	–Appreciation of multiple perspectives
	–Problem solving in real world situations
	–Collaboration in the learning process
	–Opportunity for students to publicly share their work, revise their work based in social critiques, and reflect on what they have learned with others

Development is where a child's (or novice's) spontaneous concepts meet the order and logic of adult (or expert) reasoning. Intersubjectivity refers to the mutual understanding that is achieved between people through effective communication. Enculturation is the process whereby the currently established culture enables an individual to learn the accepted norms and values of the culture or society in which the individual lives. In social constructivism, the meaning-making that is learning occurs through the process of intersubjectivity in the enculturalized Zone of Proximal Development. That is, learning occurs through communication with peers and experts or seniors in a context related to real life tasks. Table 1 summarizes the characteristics and applications of social constructivism for learning.

When interaction has a direct influence on a learner's intellectual growth, we can say the interaction is meaningful (Hirumi, 2002; Vrasidas & McIssac, 1999). In an online learning environment designed on the principles of social constructivism, meaningful interaction should include responding, negotiating internally and socially, arguing against points, adding to evolving ideas, and offering alternative perspectives with one another while solving some real tasks (Jonassen et al., 1995; Lapadat, 2002; Lave & Wenger, 1991; Vrasidas, 2000; Vygotsky, 1978). Fig. 1 illustrates the concept of meaningful interaction in social constructivism.

While engaging in authentic learning tasks with various people including peers and experts, learners engage in defining the task, generating ideas, sharing resources and perspectives, negotiating, synthesizing individual thoughts

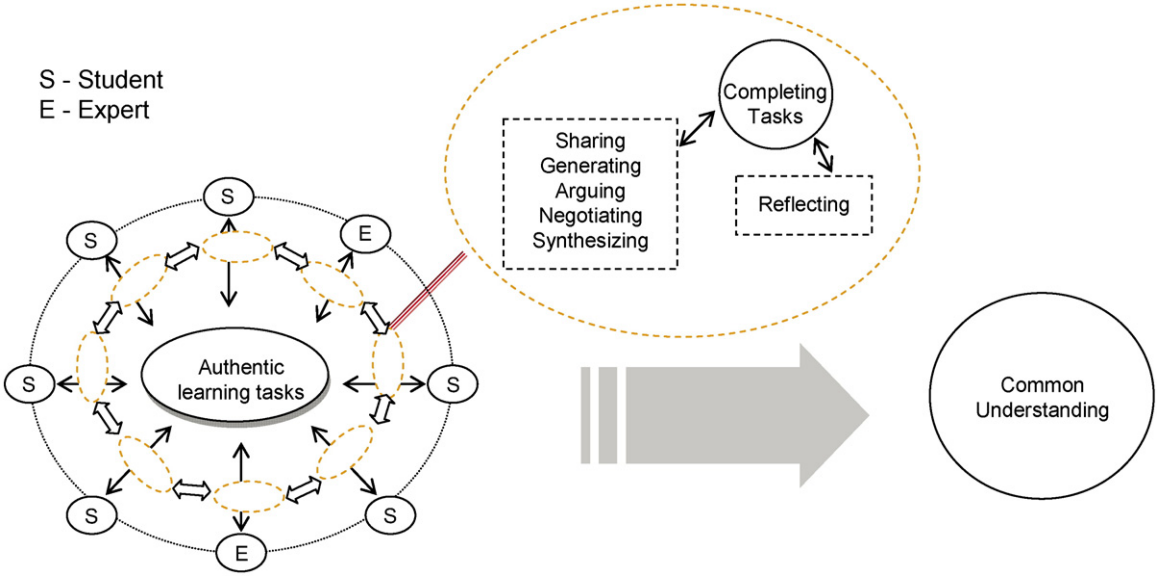

Fig. 1. Meaningful interaction in social constructivism.

with those of others, completing the tasks, and refining them on the basis of further sharing of insights and critiques. When learners are faced with confusion or conflict, they discuss the issues with one another at first and then they try to negotiate internally and socially to solve the problem. Finally, they arrive at some common understanding. Such a meaningful interaction process is required for meaning making and hence learning.

4.1. The web as a context for meaningful interaction in social constructivism

With the development of the Internet and its communication and sharing affordances such as Email, chat, Web discussion forums, and other technologies, people are being exposed to more varied and frequent interaction opportunities than humans have ever experienced before. According to Tapscott (1998), those under the age of twenty-five "embrace interaction media such as the Internet/web, CD-Rom and video games" (p.22), and according to Oblinger (2003) the students in what she calls the Net Generation simply cannot imagine their life without the Internet and computer technology. Web-based interaction for learning would seem to be a very attractive option for learners who experienced their formative adolescent years since the development of the easily browsed Internet, but more research is needed before this conjecture is validated.

Herrington and Oliver (2000) and other online learning experts have asserted that educational applications of the Web can support and improve highly effective types of learner-to-learner interactions based upon social constructivist learning theory. Internet communication tools, such as E-mail, listservs, and bulletin boards, allow learners to exchange information, contribute to discussions, and provide opportunities for learners to acquire examine alternative perspectives easily. Learners can communicate interactively one to one or in-groups, making possible opportunities for collaboration such as team projects. Online teachers can provide, through various communication tools, guidance, advice, coaching, and feedback (Hong, Lai, & Holton, 2001). Moreover, the interactive nature of the Web allows learners to explore a variety of resources and establish connections with other knowledge domains that are meaningful to them (Jonassen, 1996; Vrasidas, 2000). But meaningful interactions are unlikely to occur without the provision of an instructional design model that fosters them.

4.2. Web-based authentic tasks and meaningful interaction in social constructivism

Authentic tasks have become the center of attention for some researchers focused on employing social constructivist as a theoretical foundation for Web-based learning (Herrington, Reeves, Oliver, & Woo, 2004; Lourdusamy, Khine, & Sipusic, 2002). Using authentic tasks is derived from the social constructivist principle of locating learning in realistic contexts (Stage et al., 1998). The use of authentic tasks is also advocated to foster learning transfer in the belief that the collaboration among students helps them learn not only the concepts under discussion but also how these concepts are used in the workplace or in life (Jaworski, 1994). To accomplish an authentic task, students must interact through sharing what they are thinking, relating their ideas to past experiences, collaborating with their peers, actively constructing their own meaning, and incorporating the diverse perspectives of others (Barr & Tagg, 1995). This is an example of the meaningful interaction process supporting the process of intersubjectivity in the enculturalized ZPD. In particular, if students work together with other people including peers, experts, and seniors while solving an authentic task, this approach highlights the emphasis social constructivists place on the construction of knowledge through mediation and negotiation within a learning community. It is also highlights the process of working closely with an expert who provides a model and gradually socializes the student into the culture of the profession or field (Gardner, 1991).

Given the potentiality of authentic activities for supporting meaningful interaction, several researchers have tried to identify the characteristics required for its effective application in educational contexts. For example, Newmann and Wehlage (1993) outlined five standards for authentic activities: 1) higher order thinking; 2) depth of knowledge; 3) connectedness to the world; 4) substantive conversation; and 5) social support for students. Sheurman and Newmann (1998) provided three criteria of authenticity: 1) construction of knowledge, 2) disciplined inquiry, and 3) value beyond school. According to Perreault (1999), authentic activities typically require more class time than do traditional workbook exercises. Authentic activities also require a range of cognitive skills, some easier to assess than others. Recognizing that learning assessment must reflect the important components of the activity, Perreault suggested that portfolios and scoring guides (or rubrics) can be effective means of assessing the learning stemming from authentic activities. Ideally, students may be involved in the creation of the scoring guides and rubrics.

Among these efforts, the most representative and comprehensive one may be the one made by Reeves, Herrington, and Oliver (2002) to identify guidelines for educational applications of authentic activities within online learning environments. They identified the following ten main characteristics of authentic activities:

1. Authentic activities have real-world relevance.
2. Authentic activities are ill-defined, requiring students to define the tasks and sub-tasks needed to complete the activity.
3. Authentic activities comprise complex tasks to be investigated by students over a sustained period of time.
4. Authentic activities provide the opportunity for students to examine the task from different perspectives, using a variety of resources.
5. Authentic activities provide the opportunity to collaborate.
6. Authentic activities provide the opportunity to reflect.
7. Authentic activities can be integrated and applied across different subject areas and lead beyond domain-specific outcomes.
8. Authentic activities are seamlessly integrated with assessment.
9. Authentic activities create polished products valuable in their own right rather than as preparation for something else.
10. Authentic activities allow competing solutions and diversity of outcomes.

Before the development of computers and Web technologies, it was difficult or impossible for instructors or instructional designers to use authentic activities in real life settings because of the limitations of the subject matter, costs, time restrictions, practical constraints such as physically moving students to fields of practice, and risks of danger in the field (Herrington et al., 2004). However, with the development of Web technology, such limitations are decreasing. The Web offers access to an enormous amount and variety of relevant content. Instructors can provide information about the latest research results as well as practical examples of the applications of research. The information can be presented in forms such as text, graphics, audio, video, and virtually any combination of these. With the information, students can conduct exercises, play serious learning games, and even engage in virtual reality simulations on the Web with little or no risk.

Despite the obvious advantages of the Web, relatively few authentic web-based learning programs have been developed and implemented at various levels of education. But progress is being made. According to Winn's (2002) review, many science related programs and research projects now employ Web-based authentic activities such as "astronomy (Barab et al., 2000), meteorology (Hay, 1999), physical oceanography (Winn and Windschitl, 2001), maintenance of nuclear reactors (Kashiwa et al., 1995), subatomic chemistry (Byrne, 1996), and global warming (Jackson, 2000)" (p. 337). In these and similar authentic projects, students participate in scientific investigations conducted jointly with other students and experts online.

Herrington et al. (2004) described a *Graduate Certificate in Online Teaching and Learning* that has been developed using the characteristics of authentic activities listed above at a university in Western Australia. The authors described one of the courses in the certificate program as follows:

> The first course entitled *Online Teaching and Learning* was designed to explore issues associated with the creation of effective learning environments, and draws heavily on recent theory and research. The course is based upon a task wherein the student takes on a role in a scenario set in a fictitious university. The student is required to evaluate a website that has been set up as an exemplar for a consortium of universities planning to develop a joint online course. The students then, in collaboration with other students (posed as representatives from the other universities,) recommend a set of guidelines for website development, and then redesign the original website (or one of their own choosing) according to those guidelines. (p. 14)

In such a Web-based authentic learning environment, students draw their information from various sources for their projects, use powerful communications tools and networks for various kinds of collaboration, and learn critical global and information-age skills as well as context related knowledge and skills (Newman, 1994). But questions remain about the degree to which students become actively engaged in authentic tasks online and whether learners actually view their interactions as meaningful.

5. Recognizing meaningfulness in online interactions

As noted above, when interaction influences students' meaning making and increases learning effects, we can say that interaction is meaningful. But this statement is obviously somewhat tautological. How can we really know whether interaction has affected learning through the process of intersubjectivity, especially in Web-based learning environments? Does the use of authentic tasks guarantee meaningful interaction? Certainly not. If we design a Web based learning environment using authentic tasks, the success depends on many factors including the way the task is presented, the scaffolding strategies instructors apply, the learners' interests and motivation, and so on. When an online learning environment is designed around authentic task, unexpected factors may emerge and some expected results are not always predictable. Therefore, to increase meaningful interaction and to design and apply better interaction activities in Web-based learning environments, the interaction processes need to be analyzed and understood in terms of learning.

Fortunately, many contemporary Web-based learning environments automatically create text-based archives or transcripts of interactions that occur during online learning (Harasim, Hiltz, Teles, & Turoff, 1995). Different approaches to content analysis or discourse analysis can capture the richness of the student written interaction in Web-based learning environments. Content analysis is a generic name for a variety of textual analyses that typically involves comparing, contrasting, and categorizing a set of data (Schwandt, 1997). Discourse analysis has an analytic commitment to studying discourse as texts and talk in social practices (Potter, 1997). Discourse analysis differs from content analysis in that content variables are not predetermined and fixed but evolves in iterative readings of the text. The unit of analysis is of various length spanning sentences, paragraphs, pages, even whole texts (Davis & Brewer, 1997; Potter, 1997). To compensate for the weak points of each method, content analysis and discourse analysis are often used together. Several researchers have developed models and tools to facilitate the analysis of the data representing online interaction (Gunawardena, Lowe, & Anderson, 1997; Henri, 1992; Johnson & Johnson, 1996). As illustrated in Table 2, there are a variety of ways to analyze written online interaction (Campos, 2004).

Table 2
Interaction analysis models

Researchers	Research purpose	Unit of analysis	Analysis model	Published journal
Henri (1992)	To propose a content analysis method to assess learning processes	Meaning	Developing a five level analytical model including participative, social, interactive, cognitive and metacognitive dimensions	Collaborate learning through computer conferencing: The Najaden papers
Gunawardena et al. (1997)	To introduce a model of analysis to assess the social construction of knowledge and collaborative learning.	Message	Developing a five phase evolution of negotiation leading to the co-construction of knowledge: Sharing/comparing information, Discovery and exploration of dissonance, Negotiation of meaning/Co-construction of knowledge, Testing and modification of proposed synthesis, Phrasing of agreement, statement, and application of the newly constructed meaning	*Journal of Educational Computing Research*
Kanuka and Anderson (1998)	To understand and assess the learning that occurred during an online forum	Message	Using the model of Gunawardena, Low and Anderson complemented with discourse analysis	*Journal of Distance Education*
Hara, Bonk, and Angeli (2000)	To explore how electronic environments encourage higher-order cognitive and metacognitive processing	Paragraph or idea.	Using a transformed Henri method	*Instructional Science*
Fathy, Crawford, and Ally (2001)	To understand patterns of computer-mediated interaction	Sentence	Developing a tool named TAT (Transcripts Analysis Tool)	*International Review of Research in Open and Distance Learning*
Garrison, Anderson, and Archer (2001)	To introduce a practical approach to assess the nature and quality of critical discourse and thinking in a computer conference	Message	Developing an inquiry model, which focuses on cognitive presence	*American Journal of Distance Education*
Campos (2004)	To study conceptual change, higher order learning, and knowledge building in online communication	Sentence	Discourse analysis method referred to as ecological constructivist perspective	*Journal of Asynchronous Learning Network*

Based on a specific learning situation or research purpose, the most appropriate analysis model can be chosen from the models listed in Table 2 or developed anew. However, to increase learning and meaningful interaction, the important components of meaningful interaction mentioned previously specified should be checked during the analysis process regardless of the approach taken. That is, we should try to understand the following:

- how learners communicated actively with various people including peers and experts;
- how learners faced the inevitable conflict situations that arose during discussion,
- how they actively negotiated internally and socially to solve those situations; and
- how finally they arrived at some common understanding through those processes.

Based on the results, we will hopefully begin to understand clearly the nature of interaction and learning processes it enables. Based on this understanding, we can better manage and facilitate the interaction process as well as design more effective learning environments.

6. Conclusion

In order to improve the research and development related to Web-based learning, we recommend re-conceptualizing online interaction in terms of meaningful learning based on social constructivism learning theory. Meaningful interaction occurs in the process of intersubjectivity in the enculturalized ZPD (Fosnot & Perry, 2005; Driscoll, 2000; Jonassen et al., 1995; Lave & Wenger, 1991; Vrasidas, 2000; Vygotsky, 1978). Meaningful interaction should include responding, negotiating internally and socially, arguing against points, adding to evolving ideas, and offering alternative perspectives with one another while solving some authentic tasks (Jonassen et al., 1995; Lapadat, 2002; Lave & Wenger, 1991; Vrasidas, 2000; Vygotsky, 1978). As representative examples of meaningful interaction, we referenced a few notable attempts that use authentic activities in web-based learning environments (Herrington et al., 2004). In addition, we discussed the need for understanding and assessing the meaningfulness of online interaction through careful analysis. The bottom line is that to increase the learning effects of online interaction, we should, first of all, understand clearly the nature of interaction within the framework of social constructivist learning theory. Once we gain such an in-depth understanding, we should be able to engage in productive research and development to identify the necessary design principles for implementing more effective interaction activities within Web-based learning environments.

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