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Interaction in Distance Education and Online Learning: Using Evidence and Theory to Improve Practice

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ABSTRACT

In a recent analysis of distance and online learning, we quantitatively verified the importance of three types of interaction: among students, between the instructor and students, and between students and course content. We highlight several evidence-based approaches that may be useful in the next generation of distance and online learning. These include principles and applications stemming from the theories of self-regulation and multimedia learning, research-based motivational principles and collaborative learning principles.

Keywords: Distance education, Online learning, Self-regulation, Multimedia learning, Motivation, Collaboration, Instructional design, Cooperative learning, Metacognition

Distance and online learning provide exciting opportunities for not only increasing the reach of education and reducing its cost, but, most important to us, for increasing the quality of teaching and learning. In looking forward, we combine the results of our latest distance education review with summaries of evidence from other areas to suggest directions for the future.

An overview of the past

An examination of the quantitative/experimental research literature of DE and OL reveals

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an inordinately large proportion of comparisons with classroom instruction (CI). There is general consensus of the effectiveness of all forms of DE compared with classroom instruction. There is wide variability among studies, from those strongly favoring DE to those favoring CI. There is a tendency for researchers to describe the DE/OL condition in great detail while characterizing the CI condition as ''traditional classroom instruction,'' thereby diminishing the opportunity to describe and compare salient study features.

The next generation research

A fundamental shift in the culture of research practices and the quality of reporting needs to occur to enable systematic reviewers and meta-analysts to come to broader and more comprehensive generalizations about the processes and conditions under which learning is best supported in DE and OL course designs. These include:

- more research that compares at least one DE/OL treatment to another DE/OL treatment with an emphasis on learning and motivational processes;
- better research designs;
- more studies across the grade levels (k-12) and in higher education settings of all types;
- better-quality descriptions of all treatment levels and how well they were implemented;
- better-quality measures, particularly measures of student learning, higher order thinking and engagement; and
- better-quality reporting, preferably the inclusion of full descriptive statistics.

Interaction in DE and OL

The DE/OL literature is largely univocal about the importance of interaction. This is because of the integral role that interaction between students, teachers and content is presumed to play in all of formal education and because interaction was largely absent during so much of the early history of DE. But is there empirical evidence that interaction is important and what forms of interaction are best?

Types of interaction

An interaction is commonly understood as actions among individuals, but this meaning is extended here to include individual interactions with curricular content. Moore (1989) distinguished among three forms of interaction in DE: (1) student– student interaction, (2) student-instructor interaction; and (3) student-content interaction. Student–student interaction refers to interaction among individual students or among students working in small groups (Moore 1989). In correspondence courses, this interaction is often absent; in fact, correspondence students may not even be aware that other students are taking the same course.

In later generations of DE, including two-way video- and audio-conferencing and Web-based courses, student– student interaction could be synchronous, as in videoconferencing and chatting, or asynchronous, as in discussion boards or e-mail messaging. Student-instructor interaction focuses on dialogue between students and the instructor. According to Moore (1989), during student-instructor interaction, the instructor seeks ''to stimulate or at least maintain the student's interest in what is to be taught, to motivate the student to learn, to enhance and maintain the learner's interest, including self-direction and self-motivation''. In DE environments, student-instructor interaction may be synchronous such as through the telephone, videoconferencing and chats, or asynchronous such as through correspondence, e-mail and discussion boards. Student-content interaction refers to students interacting with the subject matter under study to construct meaning, relate it to personal knowledge, and apply it to problem solving. Moore (1989) described student-content interaction as ''… the process of intellectually interacting with the content that results in changes in the learner's understanding, the learner's perspective, or the cognitive structures of the learner's mind''. Student-content interaction may include reading informational texts for meaning, using study guides, watching instructional videos, interacting with multimedia, participating in simulations, or using cognitive support software (e.g., statistical software), as well as searching for information, completing assignments and working on projects.

The positive impacts of interaction

Each type of interaction had a significantly positive average effect size ranging from student-instructor interaction to student–student interaction. Both student– student and student-content interaction was significantly higher than student instructor interaction. Not surprisingly, the major conclusion from Bernard *et al.* (2009) was that designing interaction treatments into DE courses, whether to increase interaction with the material to be learned, with the course instructor, or with peers impacts positively on student learning.

But are even larger and more consistently positive effects possible? It may be that the presence of the interaction conditions in the reviewed studies functioned in exactly the way they were intended, so that the estimates of the effects were fairly accurate. But just because opportunities for interaction were offered to students does not mean that students availed themselves of them, or if they did interact, that they did so effectively. IDE learners were able to interact but may not have done so optimally given the quality and quantity of interactions that occurred. These interactions may have been limited by how the courses used in the research were designed and delivered and limited by how technology mediated learning and instruction. Consequently, the next generation of interactive distance education (IDE), or purposeful, interactive distance education, should be better designed to facilitate interactions that are more targeted, intentional and engaging. Not only will we need knowledge tools and instructional designs that do this effectively, but we will also need research that validates

both the underlying processes (e.g., using implementation checks and measures of treatment integrity) as well as the outcomes of IDE.

Interactive Distance Education (IDE)

One way to advance this new, more interactive DE, largely possible because of Web 2.0 features, is via the development of specialized knowledge tools or customized instructional designs that take advantage of these new features. A knowledge tool is educational software that scaffolds and supports student learning. Instructional design is the practice of maximizing the effectiveness, efficiency and appeal of instruction and other learning experiences. Effective knowledge tools for IDE should be based on sound instructional design or allow instructional design templates to be added to them. Although emerging technologies offer a vast range of opportunities for promoting collaboration in learning environments, distance education programs around the globe face challenges that may limit or deter implementation of these technologies. Instructional design models must be adapted to integrate various types of interactions, each with a specific purpose and intended outcome. It is also necessary to choose the appropriate technology tools that foster collaboration, communication and cognition. Furthermore, instructional design models must anchor student interaction in the instructional objectives and strategies that create, support and enhance learning environments. Beldarrain (2008) explores five instructional design frameworks and assesses their effectiveness in integrating interaction as part of the design and development phase of DE. When students consider why they engage in learning activities they are reflecting on their motivation (from the Latin word ''movere'' meaning to move) for learning including the energy of activity and the direction of that energy towards a goal. When students consider how they engage in learning they are addressing the strategies and techniques for knowledge acquisition.

Evidence-based approaches to IDE

We highlight below several evidence-based approaches useful in the next generation of IDE. These include application of: (1) theories of self-regulation, (2) multimedia learning principles, (3) motivational design principles and (4) collaborative and cooperative learning principles. We also discuss challenges in integrating these principles in IDE and the instructional designs and learning tools best suited for its success.

Self-regulation principles

One important interpretation of purposeful interaction in IDE means learners will be self-regulated; they will set clear goals and develop strategies for achieving those goals, monitor their activity and reflect on their accomplishments using both self and peer or teacher feedback. Self-regulated learners are individuals who are meta cognitively, motivationally and

behaviorally active participants in their own learning and consequently are learners whose academic performance is higher than others.

A main feature of self-regulated learning is metacognition, which refers to the awareness, knowledge and control of cognition. The three processes that make up metacognitive self-regulation are planning, monitoring and regulating. Proponents of socio-cognitive models emphasize that to develop effective self-regulated learning strategies, ''students need to be involved in complex meaningful tasks, choosing the products and processes that will be evaluated, modifying tasks and assessment criteria to attain an optimal challenge, obtaining support from peers and evaluating their own work''. The three cyclical phases of self-regulation include both metacognitive and motivational components, providing the foundation for better sustainability of learning and skill development. The forethought phase includes task analysis (goal setting and strategic planning) and consideration of self-motivation beliefs (self-efficacy, outcome expectations, intrinsic interest/value and goal orientation). Learners need to set goals and make plans to engage successfully in the task as well as take stock of their own motivation toward the task. The next phase, the performance phase, includes self-control (self-instruction, imagery, attention focusing and task strategies) and self-observation (self-recording and self-experimentation). Learners need to engage in the activity, controlling their processes and observe their own performance. Finally, the self-reflection phase includes self judgment (self-evaluation and casual attribution) and self-reaction (self-satisfaction/ affect and adaptive-defensive responses) .

Though the terms are different, distance education has emphasized the need for students to be self-directed and to learn how to learn; historically this emphasis comes from the adult learning literature as early models of distance education largely catered to older learners. There is an emphasis on adults directing their own learning in a myriad of ways from monitoring their progress to setting their own learning goals. There are six key principles of his adult learning theory, two of which address adult learners' self-regulation: learners need to be aware of the learning process to be undertaken, where that process leads (the learning which will be achieved) and why the learning is important; they also need to be self-directed in their learning, taking ownership over the methods and goals of learning. Adult learners' needs to be self-directed, as illustrated by setting up goals, finding relevant resources and evaluating their own progress and the importance of supporting adults in learning how to learn. Such approaches have been criticized for placing too much emphasis on the individual, as has the concept of self-regulation. Reconciliation with more of a socio-constructivist perspective would not necessarily prohibit the concept of self-regulation, but it would be framed within the context of learners increasing their engagement in communities of practice. It is possible to create instructional designs with many of the features of self-regulation and to embed these designs as templates into existing tools for distance and online learning, especially those that are intended to support computer conferencing. But knowledge tools are emerging,

designed specifically to promote student self-regulation in blended, online and distance learning contexts.

Multimedia learning principles

Mayer (2001, 2008) describes a cognitive theory of multimedia learning organized around three core principles: (a) dual channels—the idea that humans possess separate channels for processing visual and verbal material; (b) limited capacity—the idea that each channel can process only a limited amount of material at any one time; and (c) active processing—the idea that deep learning depends on the learner's cognitive processing during learning (e.g., selecting, organizing and integrating).

These perspectives and findings about student and educator motivation and the use of educational software overlap with motivational principles for instructional design in general. Pintrich (2003) provided five motivational generalizations and 14 instructional design principles that are evidence-based. The motivational generalizations are: (1) adaptive self-efficacy and competence beliefs motivate students, (2) adaptive attributions and control beliefs motivate students, (3) higher levels of interest and intrinsic motivation motivate students, (4) higher levels of value motivate students and (5) goals motivate and direct students. Knowledge tools may be best suited to situations when learners have to be conscientiously engaged in learning, when the outcome is important and/or when the process is being judged or evaluated. Knowledge tools are also suited to situations when the outcome is uncertain and especially when student effort matters and/or when failure has occurred previously. One ideal situation is where a knowledge tool is integrated into instruction, where the task is complex and novel, where the learner wants to do well and doing well is important and when the student is not certain how well s/he will do but believes that personal efforts to learn will lead to success.

SUMMARY

In this paper, we argued for changes to primary quantitative/experimental research designs in DE/OL to examine alternative instructional treatments ''head-to-head.'' We can see limited future improvements to DE/OL if comparisons to CI continue to prevail. The results of Bernard *et al.* (2009) confirmed the importance of student–student, student-content and student-instructor interaction for student learning. The next generation of interactive distance education (IDE) should be better designed to facilitate more purposeful interaction. Guided, focused and purposeful interaction goes beyond whether opportunities for interaction exist to consider especially why and how interaction occurs. When students consider how they engage in learning they consider, or are provided with, the strategies and techniques for knowledge acquisition. We highlighted several evidence-based approaches useful in the next generation IDE. These include principles and applications from the theories of self-regulation

and multimedia learning, research-based motivational principles and collaborative learning principles. Self-regulated learning principles:

1. Include a forethought phase that involves task analysis (goal setting and strategic planning) and self-motivation beliefs (self-efficacy, outcome expectations, intrinsic interest/value and goal orientation).
2. Provide a performance phase that includes self-control (self-instruction, imagery, attention focusing and task strategies) and self-observation (self-recording and self-experimentation).
3. Integrate a self-reflection phase that includes self-judgment (self-evaluation and casual attribution) and self-reaction (self-satisfaction/affect and adaptive defensive responses).

Multimedia Learning Principles

1. Reduce extraneous processing and the waste of cognitive capacity.
2. Manage essential processing and reducing complexity.
3. Foster generative processing and encourage the use of cognitive capacity.

Motivational design principles

1. Encourage adaptive self-efficacy and competence beliefs.
2. Promote adaptive attributions and control beliefs.
3. Stimulate higher levels of interest and intrinsic motivation.
4. Insure higher levels of task value.
5. Encourage the identification of goals that motivate and direct students.
6. Participate in a context where knowledge is valued and used motivates students.

Collaborative and cooperative learning principles

1. Structure positive interdependence such that one student's success positively influences the chances of other students' successes.
2. Highlight individual accountability in ways that each student is responsible for:
   (a) his or her own learning; and
   (b) helping the other group members learn.
3. Insure promotive interactions occur allowing individuals to encourage and facilitate each other's efforts to accomplish the group's goals.
4. Maximize the likelihood that students give and receive elaborated explanations with a focus on encouraging understanding in others.

Overcoming Challenges to IDE

1. Instructional designers should pay more attention to ease of use as an overall design objective.
2. Students need more guidance about when, under what circumstances and for what purposes, to use the tool.
3. Users need practice to use the tool well and wisely.
4. Cognitive tools and learning strategies may work best when they are an integral feature of a course.

Finally, in this paper we addressed several theoretical and empirical perspectives that should be explored more fully, but we have not specified in complete detail how instructional design and technology applications should converge to achieve a more interactive environment for teaching and learning at a distance. Achieving that goal is left to the creative and collaborative efforts of future researchers, designers, software engineers and teachers.

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