The Interactivity Effect in Multimedia Learning Environments

Richard A. Robinson

Boise State University
Abstract

The inclusion of interactivity is one of the main predictors of successful learning in multimedia learning environments. Research has shown that computer-based learning systems that include interactivity yield much higher learner satisfaction rates, higher levels of achievement, and greater degrees of collaboration when compared to non-interactive environments. Designers can use some techniques and strategies such as the INTERACT model and the Ten Usability Heuristics to ensure adequate levels of interactivity. The conclusion from all of the research presented is that interactivity is a major factor for student success in multimedia learning environments. The one caveat is that instructional designers should add moderate levels of interactivity to learning systems as excessive amounts can be debilitating.
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Introduction

In the past twenty years, extant research has been conducted and many quality articles have been written on the subject of adding interactivity to multimedia learning environments. The results of many of these experiments, and the opinions of many of the writings on the subject, have been positive in nature. In fact, most of the studies revealed that when designers add interactive elements to learning systems, such as usability, control, and personalized feedback, these additions produce higher levels of student communication, collaboration, satisfaction, and achievement.

The following paper presents three definitions of interactivity, explains the interactivity effect, shows evidence that the effect exists, provides a few design strategies and techniques for fostering interactivity, and then concludes with a brief discussion. Except for the Nielsen (2005) article, all of the resources are from peer-reviewed books, journal articles, or magazine features published within the last sixteen years.

Interactivity

According to Proske, Narciss, and Korndle (2007), what constitutes an interactive computer-based learning environment are systems that “allow mutual action between learners, the learning environment and learning material” (p. 510). Further, there are three dimensions to these interactions which are the technical, social, and mental functions. First, the technical aspect of interaction is important because it affords students the ability to “search, locate, select, access, manipulate, document, and save information” (p. 511). Second, the social part refers to whether or not the technology allows the student to properly communicate with other learners, the
instructor, and the institution. Third, the mental dimension of this theory is described as the
user’s ability to access, control, and manipulate the content (p. 512).

Another definition, by Domagk, Schwartz, and Plass (2010), states that interactivity is a
“reciprocal activity between a learner and a multimedia learning system, in which the (re)action
of the learner is dependent upon the (re)action of the system and vice versa” (p. 1025). And Sims
(1997) describes the concept as when a “user who has access to a range of input devices…which
can activate the technology being used; the result of this action is some form of visual or audio
output…and the sequence of actions form an interaction” (p. 158).

These three former definitions are very similar to one another as they all describe the
same psychological dynamic. This dynamic is the ability of the user to freely interact with the
instructor, classmates, and content due to the systemic design. In other words, effective forms of
interaction can only occur if the system is highly responsive to the needs of the user and allows
for the free negotiation of the material. Any systemic barrier that exists, such as a poorly
designed navigational system, broken links to the required material, or the lack of a proper help
section, prevents interactivity from taking place and negatively affects the learning process. The
reason for this is that barriers force students to expend unnecessary metacognitive energy sorting
through disorganized interfaces, structure, and content. This psychic energy could be used in
more productive ways such as contributing to a group discussion, reading the textbook, or
researching for a final project, rather than wasting precious learning time negotiating through a
disorganized system.

The Interactivity Effect

The interactivity effect occurs when students become motivated to learn because of the
interactive elements included within the instructional design. Over the past twenty years,
considerable research has been conducted in this area and many peer-reviewed articles have been written. Most of these reports have been of the positive nature and point to a clear correlation between interactivity and eventual learner success. However, a few of the researchers mentioned that adding too much interactivity to the system can have an opposite effect on learning. The following is an analysis of seven articles related to this subject.

First, in a study of 105 university students that tested the effectiveness of a German online learning environment found a positive correlation between the amount of interactivity and learner success. In this study, learners were exposed to five different online learning environments and then tested across five dimensions. These dimensions were learning strategies and activities, student achievement before and after learning, and student acceptance (Proske, Narciss, & Korndle, 2007, pp. 519-520). The final analysis of the data revealed that the “implementation of interactivity functions is a meaningful way to improve performance.” In their summation, the author’s offered one caveat which stated that “the most important aspect of effective and successful self-regulated learning…is what the learners make out of it” (p. 529). This is true in any learning situation as no matter what level of interactivity is included if the student does not actively engage with the content, classmates, and instructor then success is unlikely.

Next, in an investigation of 33 undergraduate students in which some subjects were instructed using interactive multimedia elements and some not the researchers concluded that “adding interactivity to a computer-based lesson increase[s] the depth of learning or understanding” (Evans & Gibbons, 2007, p. 1156). In addition, the author’s stated that “incorporating interactivity in computer-based systems is that it allows the learner to influence the flow of information in terms of timing or content” (p. 1148).
In a similar study of 233 university students, Sicilia, Ruiz, and Munuera (2005) found that multimedia learners who were “exposed to an interactive Web site processed information more thoroughly than individuals exposed to a non-interactive” (p. 39). Moreover, the researchers determined that the students in the experiment “processed much more information in the interactive…design which suggests that their motivation…increases under interactive conditions” (p. 40).

In an article about interactivity and online teaching, Zundel (2006) noted that from his many years of experience as a distance instructor he has observed an anecdotal correlation between the amount of interactions a student participates in and a successful learning outcome. He also mentioned that in order for a lesson to be deemed effective then “interactivity must be designed into instruction and be consistent with the course objectives.” In other words, designers should not add interactive elements for the mere sake of adding them as the product needs to be pedagogically sound too in order to be considered an effective teaching tool. Zundel also stated that “online instruction doesn’t just happen…it requires work to design and develop interactive courseware that enables students to become effective professionals” (p. 125). More evidence concerning the negative effects of interactivity are found in Mayer and Chandler’s (2001) study of 59 college students. In the final analysis, the researchers concluded that the addition of “a modest amount of interactivity can promote deeper learning…if it is done in a theory-based way” (p. 396).

On a negative note, three of the studies revealed that adding too much interaction can have a reverse effect on the learning process and can potentially become debilitating for some of the learners. For example, Teo, Oh, Liu, and Wei (2003) tested 54 undergraduate students and also found positive learning effects associated with interactivity but they also warned that there is
a fine line that designers must straddle during the design process. The reason for this is because “if too much interactivity is provided…it will be unlikely to hold [the student’s] attention very long” (p. 300). Similarly, in a study of consumer behavior within online business environments Liu and Shrum (2009) found that in some instances the use of “interactivity may play an inhibiting role by occupying precious cognitive resources and making processing and task completion more difficult” (p. 54). Likewise, in a related paper Lawless and Brown (1997) observed that interactivity and user control are the two most important components for effective learning in this environment and stated that “unrestricted control and lack of learning goals can dampen the power of learning” (p. 127).

**Design Techniques and Strategies**

There are a few resources that designers can use as guidelines, templates, or blueprints for fostering interactivity in multimedia environments. For example, Nielsen (2005) created a list of ten heuristics related to usability that if followed create a solid interactive instructional foundation. These are important rules for designers to follow because without many of the components listed interactivity would be greatly diminished or even nonexistent. In particular, without “user control” of the system and the “freedom” to explore the content it is difficult to imagine that much substantive interaction can occur as control and freedom are two of the defining characteristics of an effective interactive system (p. 1). Finally, the help functions listed are important for users because they provide scaffolding and support of the material which is another necessary component for student success. The following is the list of the Ten Usability Heuristics:

1. Visibility of system status.
2. Match between the system and the real world.
3. User control and freedom.
5. Error prevention.
7. Flexibility and efficiency of use.
8. Aesthetic and minimalist design.
9. Help users recognize, diagnose, and recover from errors.

Another model created by Domagk, Schwartz, and Pass (2010) is considered an effective strategy and is called the Interactive Model of Multimedia Interactivity or INTERACT. According to the creators, this holistic approach to design takes into account “the affordances of the medium and the activities of the learner” (p. 1032). This model is comprised of six main dimensions. These are the learning environment, the course activities, cognitive and metacognitive factors, and the motivation, emotions, and general characteristics of the learner (p. 1026). In the discussion section, the author’s noted that this type of instructional framework “provides educators and educational designers with a process approach that allows them to design and evaluate specific interactive components for their multimedia applications” (p. 1032). This theory consider many of the aspects associated with the multimedia learning process, from the learning environment to the learning goals and objectives to the emotional and motivational state of the students. Because of this holistic approach the INTERACT model could be considered a standard model for designers as it encompasses most of the variables required for effective multimedia instruction.
Filipczak (1996) offers four basic suggestions for designers that they can use to increase the amount of interactivity within a computer-based system. For designers, these are excellent learner-centered guidelines to follow as the intention is to reduce cognitive load, gain the student’s attention, and requires interaction with the material at certain intervals. These tips also enable teachers the ability to react quickly to student difficulties and then respond with remedial help if needed. These simple tasks are as follows:

1. Add video clips that are less than 30 seconds in length.
2. Persuade students to accomplish a simple task “every 15 to 30 seconds” (p. 55).
3. Understand that some learners do not require a high level of interactivity for success.
4. Keep track of the learner’s activity and intervene when the student needs assistance.

**Discussion**

In summary, as seen in the material presented the adding of interactive elements in multimedia learning environments appears to be a fundamental ingredient for creating increased levels of student collaboration, achievement, and satisfaction. The evidence in many of these articles and experiments clearly show that learning environments devoid of interactivity are much less effective when compared to those that include it proving the existence of the interactivity effect. Given this information, instructional designers should add acceptable levels of interactivity to instruction, or a “modest amount”, because this has been shown to result in student success (Mayer & Chanders, 2001, p. 396). Future study should focus on the negative effects of interactivity as this appears to be an issue that is overlooked in most research on the subject.
References


