Distance Education, Vol. 24, No. 1, 2003

Carfax Publishing
Taylor & Francis Group

Promises of Interactivity: Aligning Learner Perceptions and Expectations With Strategies for Flexible and Online Learning

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ABSTRACT *The discourse of flexible and online learning echoes with terms such as communication, collaboration, engagement and interactivity. Of these, interactivity is frequently used to refer to an inherent quality of the medium and learning environment, with an underlying assumption that the interactive characteristics of communication with other learners or content objects is beneficial to the learning process. However, interactivity as a concept has received comparatively little research attention. To provide further insights into the dynamics of interactivity, this study reports on an investigation to ascertain the different ways people perceive interactivity, and the extent to which that interactivity adds value to the learning process. Based on a qualitative analysis of responses from 68 participants, it was found that participants indeed had specific expectations of interactivity that were not only consistent with theoretical frameworks of learning but also provided insights for the design of online collaborative learning environments.*

Introduction

The concept of *interactivity* has been understood as both an inherent and a beneficial attribute of the technology. According to the Macquarie Dictionary (1998), the word "interactive" can refer to both *having to do with things or persons which act on each other* and, with specific reference to computers, being *immediately responsive to commands, data etc, as opposed to systems arranged for batch processing*. While the latter definition is a useful means of differentiating forms of computer processing, in the context of learning the significant function of interactivity relates to things or persons acting on each other and the outcomes of that interaction. However, early optimism of the benefits of interactivity has been countered by debate on the very nature of interactivity:

> Computer-based instruction provides greater potential for truly interactive instruction than any mediated teaching device to date, excluding in many instances, the human tutor. (Jonassen, 1988, p. 97)

> In denying the possibility of difference and in elucidating *différance*, deconstruction essentially reveals interactivity to be not a conceptual unity, defined in terms of clear distinctions between antithetical terms, but as a fragmented, inconsistent, and rather messy notion encompassing both privileged and marginalised binaries, and the range of meanings in between. (Rose, 1999, p. 48)

ISSN 0158-7919 print; 1475-0198 online/03/010087-17 © 2003 Open and Distance Learning Association of Australia, Inc.
DOI: 10.1080/0158791032000066543

> No topic raises more contentious debate among educators than the role of interaction as a crucial component of the education process. This debate is fuelled by surface problems in definition and vested interests of professional educators but is more deeply marked by epistemological assumptions relative to the role of humans and human interaction in education and learning. (Anderson, 2002, p. 1)

The factors that impact on the effectiveness of the interactive learning experience are diverse, complex and dynamic, and therefore reinforce the importance of studying its characteristics. To provide a context for this study, five major areas are identified from which concepts of interactivity have arisen. The first relates to educational psychology (Alessi & Trollip, 2001, and Driscoll, 2000, provide excellent analyses of the major fields) while the second focuses on theory and research that specifically addresses the construct of interactivity (e.g., Moore, 1991; Sims, 1997). The third area relates to the technology with which flexible and online environments are now reliant and the criticality of human–computer interface factors (Sims *et al*., 2002). The fourth aspect is that of communication and collaboration, considered as the cornerstone of learner and teacher communication and feedback, especially where online environments are deployed (Sims, 2003). Underpinning each of these elements is the fifth area, which focuses on the way learning environments are designed, deployed and maintained (Hedberg & Sims, 2001; Sims & Jones, 2002).

With respect to the first of these areas, the genesis of interactivity in relation to the enhancement of computer-facilitated learning environments can be traced to the essential attributes of behaviourist, cognitivist and constructivist psychology (Alessi & Trollip, 2001). Whereas the behaviourist perspective provided a model for the creation of programmed texts, individually-prescribed instruction and the formalization of instructional systems development principles, the cognitive approach to learning focused on the process of knowing and the internal constructs or schema by which learning is enabled. The latter included elements such as perception of, attention to and encoding of relevant information, the impact of motivation as well as the individual's mental model of the learning environment and the locus (learner or system) of control. The current emphasis for effective learning has extended these cognitive principles to integrate those embracing a constructivist or generative perspective, which includes a focus on learning rather than teaching, situated learning, anchored instruction and reflective thinking. Ultimately, one measure of the extent to which learners have succeeded is the way in which they establish meaningful engagement and deep learning with the content, the learning activities and the course participants (Craik & Lockhart, 1972; Driscoll, 2000; Kearsley & Shneiderman, 1998).

With respect to the second area identified, research into interactivity can be traced to at least two distinct disciplines. First, from the field of distance education, Moore (1989) distinguished three types of interaction: learner–content, learner–instructor and learner–learner, which were extended by Hillman *et al*. (1994) to include learner–interface interaction. These provide a useful model by which the interactivity between learners and computers can be considered, especially those environments where online technology is the key element, as there is clearly distance between the designer of the learning context and the learner who experiences it. Moore (1991, p. 2) labelled this the transactional distance, "the physical separation that leads to a psychological and communications gap, a space of potential misunderstanding between the inputs of the instructor and those of the learner." Wagner (1994) added that the four

interactions identified can change learners and move them toward achieving goals, although more work is required to better understand the barriers that may be imposed by transactional distance on effective interaction. Additional research has also been undertaken in examining the learner–content interactions specifically within the context of computer-based learning environments. For example, Schwier and Misanchuk (1993) differentiated between reactive and mutual interactions while Sims (1997) described different levels of interaction, arguing that engagement would be more likely to occur when learners were actively working with content materials. Aldrich *et al*. (1998) also reflected this view, determining that successful learner–content interactions required opportunities for both manipulation and experimentation.

In effect, the combination of educational psychology and interactivity research demonstrate that effective interaction is not only multi-dimensional (and these dimensions continue to be analysed and extended as described by Sims *et al*., 2002) but also dependent on the ways in which learning activities and teaching strategies are implemented. Confounding this even further are the remaining two aspects identified—the requirement to work with networked technology and the ability to communicate electronically with other learners.

The literature on human–computer interface is extensive and its relationship to interactivity concerns the way course participants gain access to and manage their online learning activities. However understanding interactivity goes beyond the ways in which human–computer interaction affects the psychology of learning, and consideration must also be given to the context in which the learning environments are presented. For example, Laurel (1991) introduced the concept of *computers as theatre* as a metaphor for understanding the human–computer relationship, and if the environment is constructed as a play, what role will the learner take, one of audience or actor? If the latter, what form of actor: improviser, performer or understudy? Equally important is the integration of narrative, and the way in which the learner interprets the "stories" embedded within the learning environment. Plowman (1996) examined ways in which children explored interactive videodisk products, and determined that those where narrative was evident provided a better learning experience. Similarly, Sims *et al*. (2002) argued that narrative was a key factor for the implementation of effective online learning environments.

Intrinsic to interactivity, and representing the fourth area, is the means by which learners can communicate and collaborate within the learning environments they inhabit. The significance of communication is acknowledged by Kristof and Satran (1995, p. 121):

> In the end, interactivity is people using new media to communicate ideas, knowledge, and art in much the same way that people have always communicated. The core of good interactive communication is still a strong message and a clear presentation. The design process still calls for research, creativity, and skilful execution. The one new variable is the element of audience choice. And choice can take users in unpredictable directions and combine elements of the design in unpredictable ways. That's why interactivity calls for a greater commitment to planning, to useability, and to making the pieces work together than communication has ever demanded before.

Similarly, with the increasing presence of online learning environments, the constructivist framework also advocates cooperative and collaborative learning elements and the creation of learning communities. Taking advantage of these options means not only implementing the appropriate network infrastructure (Smissen & Sims, 2002) but also ensuring that the design

and maintenance of such environments are consistent with institutional operations and policies. Given the recent prioritization of online and e-learning at education symposia, it is evident that the interaction options available are increasing in complexity and require ongoing reflection and investigation.

As digital and networked technologies continue to develop at an unprecedented rate, providing new opportunities for educational innovation as well as new challenges for the teacher and learner to master, so too must design strategies be considered. Identified as the fifth critical element for successful interactions for online and flexible learning, design techniques need to incorporate both technological and theoretical understandings. The success of the technology as an artefact of learning environments will therefore be dependent on appropriate learning designs being utilized and the ability of the individual learners to interact effectively through the human–computer interface.

Given this overview, it is argued that only through addressing the elements of educational psychology, interaction research, the human–computer interface, communication and design can interactivity be fully understood. However, in the context of online and flexible learning, interactivity does not appear to be generating the educational outcomes predicted. The promise that computer-based interactive learning will provide a range of benefits to the overall learning process has not been consistently realized. Therefore, to extend the theoretical understanding of interactivity into that of practice, a research study was implemented to investigate the link between people's expectations of interactivity and the theoretical characteristics identified.

Methodology

One means of gathering information about the ways people understand a poorly defined or understood concept is through a questionnaire or survey. This technique was employed to elicit written responses about different aspects of interactivity. For this study, three open-ended questions were posed to focus on specific aspects of the relationship between interactivity and learning:

(1) *What do you see as the major benefits of interactivity to the learning process?* The first question was designed to develop understanding of perceptions of interactivity to enhance learning, as it has been considered to be the significant element in providing enhanced flexible and online learning environments.
(2) *What do you see as the major characteristics of interactivity?* This question was designed to focus on the indicators of interactivity and the operational characteristics of its implementation—what makes something interactive?
(3) *What makes an educational multimedia product interactive?* This question was designed to give participants the opportunity to reflect on their understanding of the word interactive in the context of the learner–content component of interactivity.

The participants ($n = 68$) were students studying an undergraduate course in multimedia and interactive learning at an Australian regional university. Based on demographic data collected, participants were grouped either by prior experience (PE, $n = 21$) or no prior experience (NPE, $n = 47$) and by gender (male: $n = 40$; female: $n = 28$). Experience is important as it can affect the speed by which a new environment is internalized into a working mental model (Alessi &

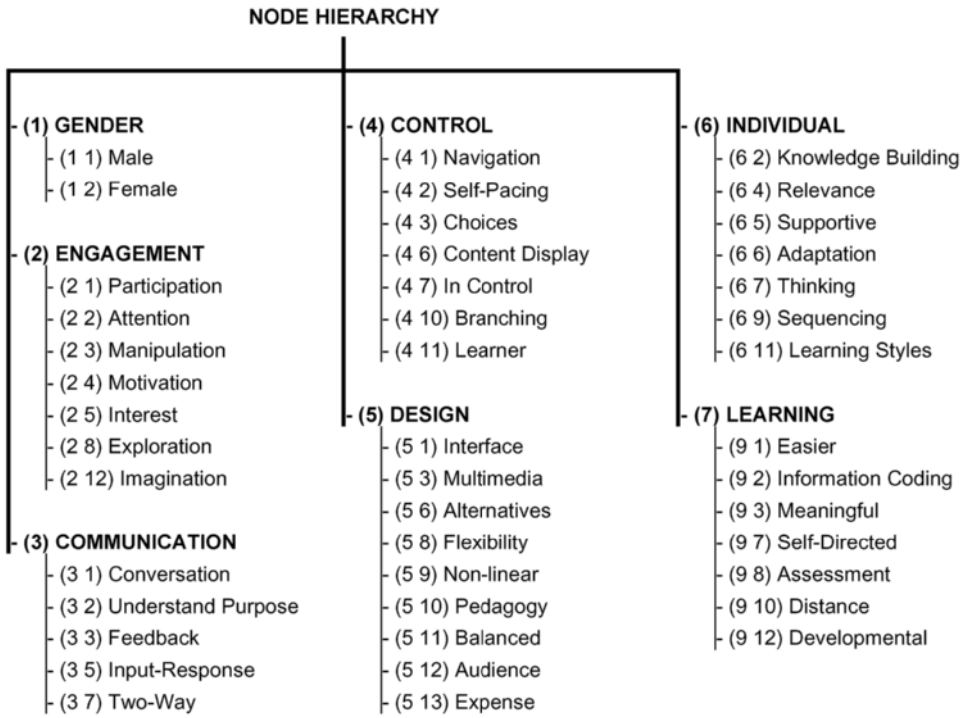

FIG. 1. Node hierarchy from question responses.

Trollip, 2001) and information on gender differences can assist in the design of learning environments to meet individual needs.

As an exploratory study investigating the phenomenon of interactivity, this investigation used a qualitative approach to analyse survey responses. To assist with this process, NUD*IST (Non-numerical Unstructured Data*Index, Searching and Theorizing) was employed. The process involved assigning each response to a category (node) based on its content. This process resulted in the creation of six files, three for the PE group and three for the NPE group. A total of 384 individual text units (responses) were coded to nodes, 153 from the PE group and 231 from the NPE group.

The process of assigning each response to a node resulted in categories being grouped according to like themes, with the hierarchy of nodes illustrated in Figure 1 being created. The node hierarchy is developed through an iterative process, supported by NUD*IST, where individual responses are classified based on the particular theoretical position represented. The six themes represent the major categories derived from the coding, with the sub-themes representing the range and form of responses within its "parent" node.

The following analysis examines the response distribution to each of the three questions in relation to their allocation to the six nodes and associated sub-nodes, with the number of text units coded to a node represented as a percentage of the total number of responses for that question. The analysis includes consideration of the variation in responses to each question based on gender and experience, and selected responses made by participants are included to highlight their description of the node or sub-node under discussion.

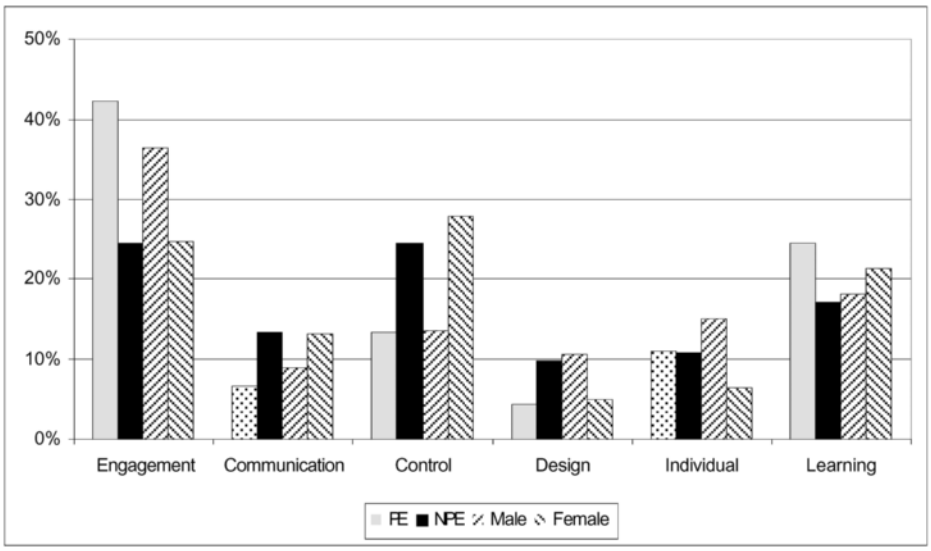

FIG. 2. Responses coded by experience and gender for Question 1.

What Do You See as the Major Benefits of Interactivity to the Learning Process?

The first question was posed to ascertain the extent to which the perception of interactive learning was consistent with pedagogical frameworks, specifically in terms of benefits accruing from interactive environments. Figure 2 shows the coding distribution of responses by experience and gender, while Fig. 3 shows the coding distribution for all responses to this question.

When participants' perceptions of major benefits of interactivity were analysed by gender, female participants tended to place more emphasis on Control whereas the male respondents identified Engagement as the predominant characteristic of interactivity. In comparison to responses coded for the other two questions, these responses show more inconsistency between male and female participants. The variation between responses also reflects the different expectations and perceptions based on experience. The PE group, having studied at least a year of interactive learning subjects, identified the importance of Engagement and Learning, while those less experienced (NPE group) identified Control, Engagement and Learning as factors that make learning environments interactive. This reinforces the importance of prior experience in terms of the tasks, activities and support that are provided to individuals when they participate in networked environments and the responsibility of design teams to address such factors (Sims & Jones, 2002).

Overall, Engagement was one of the stronger themes to emerge. This emphasizes users' expectations that they will become involved in the learning process. While a computer-mediated human–human interaction can emphasize this aspect of learning, implementation of engaging human–content interaction for the independent learner remains complex. Based on these participants, however, it would appear that users expect some form of active facility with any form of interaction, rather than presentation of information, which then has to be interpreted in other ways. There is an expectation, therefore, that the environment will provide

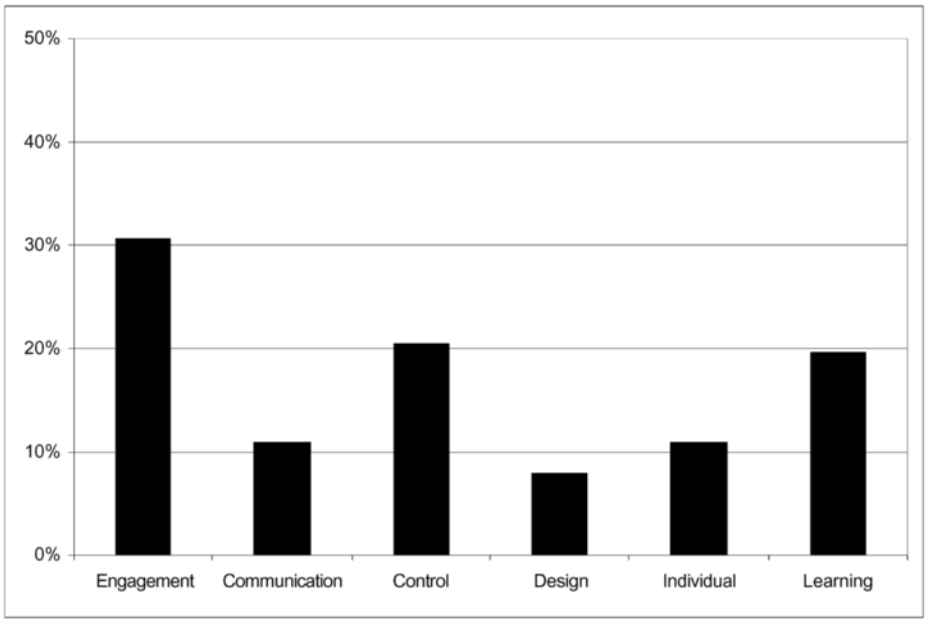

FIG. 3. Percentage of responses coded to nodes for Question 1.

some means to deconstruct the information according to a user's particular requirements. This is indicated in the following responses:

> That the learner is part of the learning process and feels involved and comfortable.
>
> When the learner can do or experiment with the concepts given then learning is more likely to occur because they did it themselves, were interested to follow the concepts to a conclusion, were free to experiment in a safe environment.

Communication is considered one of the major benefits of collaborative learning environments. This featured as a major theme in each of the questions. However, with respect to the benefits to interactivity and learning, it did not feature as highly in the responses coded (11% or $n = 14$). One explanation for this low response might be that users are more focused on their own learning and therefore perceived engagement and control as being more important. Given this condition, it may be that the underlying communication provided through a computer-based learning environment enables both effective control and subsequent engagement and therefore the extent to which communication and conversation can be successfully embedded within the interactive medium is dependent on those factors.

Closely associated with communication and conversation is Control. The difference between a learner controlling an environment and being "in control" of that environment may be a critical element in determining the success of the communication and two-way flow of information, highlighting the interrelationships between learner–learner, learner–content, learner–teacher and learner–interface interactions. With respect to the responses, 20% ($n = 26$) were coded to this node, and the particularly interesting outcome is the way in which participants clearly identified a desire to be in control of the interactive process, yet did not

appear to object to being guided or directed towards certain gaols. Given the amount of research on Control, which has typically undertaken a binary comparison of Program versus Learner Control, these selected responses and observations suggest that control is a much more subtle aspect of the overall interactive process:

> The ability to learn at your own pace. Feeling in control of your own learning. Being able to access a wide range of information to build your own level of knowledge and understanding.

> Student can tailor learning to personal needs—(to some extent); variety of system responses makes for more interesting experience; potential to include more information without it needing to be relevant to all, or most students; feeling of control over the learning experience may increase student's acceptance and enthusiasm.

Overall, the responses linked with control support the provision to users of options to choose a discussion thread, move to another topic or control the number of responses shown on screen. However, users also need to be offered that control in the context of the learning strategy being employed. More importantly, learners need to be aware of when that control can be used. It is not so much that the user has to have overall control, but rather that the user needs to have an understanding of and control over their role in the learning process. This cannot be achieved unless a suitable form of communication emphasizing the critical links between the various factors that impact on the dynamic of interactive learning has been established.

A series of responses were also coded to the Design theme (8% and $n = 10$). When considered in terms of the question, these responses remind providers of networked and flexible learning environments that underpinning the overall interactive experience for the learner are the structures and strategies implemented by the designer. The extent to which the learner effectively processes these will also be critical to the overall success of the interactive experience. The value of an adaptive and individualized encounter within learning environments would appear to be manifested when the user is fully aware of the extent to which they can communicate with others, pursue content and investigate ideas. If the environment does not provide these options and sense of purpose, then the ability of the user to control that individual experience will be diminished.

The ability of the environment to cater for individual requirements is closely linked to the control provided to the learner and the subsequent engagement and communication. However, it is the outcomes that are ultimately important, and the benefits of interactivity to the learning that are also important. For the Individual node, 11% ($n = 14$) of responses were coded as represented by the following:

> Different people interpret different information in different ways depending on the information presented or presentation style. Interactivity allows the user to guide the way information is presented in order to make the learning most efficient.

> Interactivity can prevent learning from becoming boring because the user must stay alert and play an active role. The absence of boredom allows for better retention of information by the learner.

Finally, 20% ($n = 25$) of responses were coded to the broad theme of Learning, suggesting it

is understood to be one of the major benefits of working with interactive environments, as shown by the following response:

> Interactivity can prevent learning from becoming boring because the user must stay alert and play an active role. The absence of boredom allows for better retention of information by the learner.

The important aspect of this outcome is that people expect learning to result from working in computer-based learning environments. It is therefore critical that these expectations are met by ensuring that any investment applies appropriate knowledge in terms of the five factors identified as informing this study—appropriate educational psychology, interactivity, human–computer interaction, communication, and design.

The first question aimed to identify from individual participants the components of interactivity that can be associated with learner–content interactions. The specific themes to which the responses were coded are consistent with those within the theoretical literature, focusing on elements such as Communication, Control and Engagement. These responses were also consistent with current learning theories (cf. Driscoll, 2000) and reinforce the need for designers to be aware of individual differences, to maximize the level of two-way communication between learner and application and to support the learner being in control of their learning activities.

What Do You See as the Major Characteristics of Interactivity?

The second question focused on the specific characteristics of interactivity and aimed to provide a means of identifying any discrepancies that may exist between practical expectations and theoretical prescriptions. Identifying such gaps can better inform designers in their construction of flexible learning environments. Figure 4 illustrates the coding distribution of responses by experience and gender, while Fig. 5 represents the coding distribution for all responses to this question.

Responses were similar for both male and female participants, with Communication, Design, Engagement and Control the dominant themes emerging from the coding process. Participants also recognized the importance of an environment to operate in a two-way, conversational format. As no responses were coded to the Learning node it can be surmised that interactivity was perceived as a determinant of learning and therefore consistent with other responses.

Nevertheless, small variations emerged where male participants prioritized the Communication and Design themes while female participants favoured Communication and Engagement. Further investigation of gender differences and interactivity may provide insights into the ways in which collaborative learning can be developed to cater for such differentiation within the target population. When the responses to this question are considered in relation to experience (see Fig. 4), the group with prior experience (PE) provided responses that emphasized Engagement, Control and Communication. In comparison, responses from the less experienced participants (NPE) identified Communication as the major theme by which interactivity could be characterized. This provides further evidence that novice or inexperienced users of network and flexible learning may require more input from the instructor, in the form of expectations, conversation and feedback, than those with a higher degree of confidence.

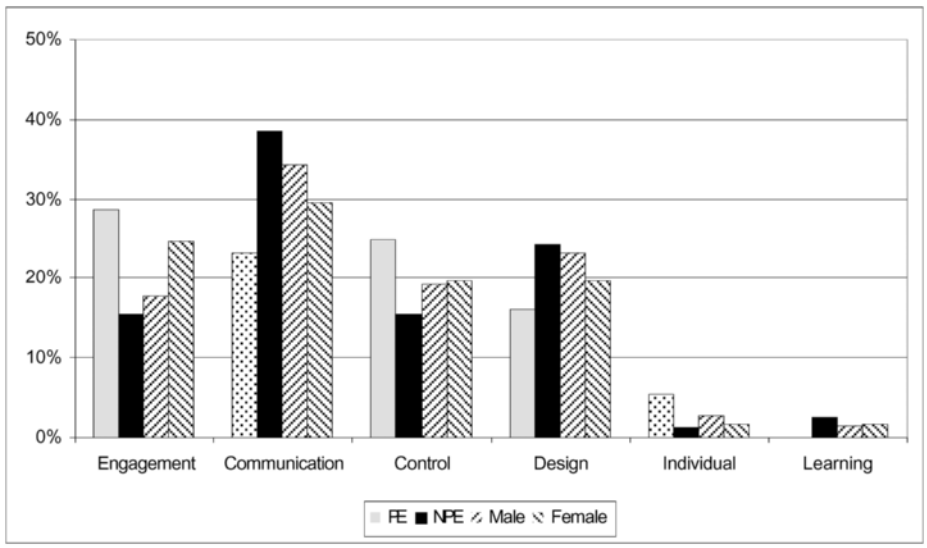

FIG. 4. Percentage of responses by experience and gender for Question 2.

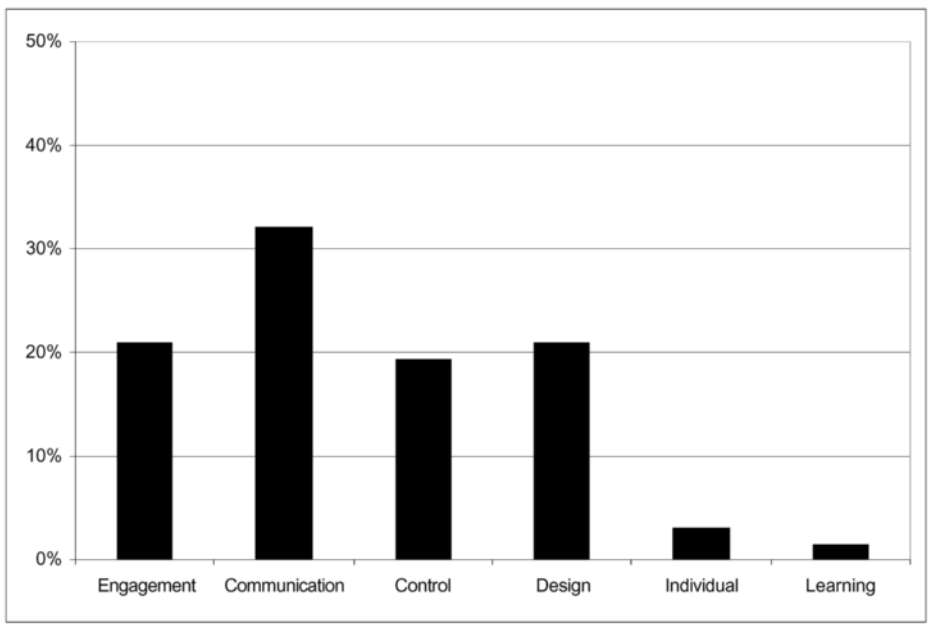

FIG. 5. Percentage of responses coded to nodes for Question 2.

Factors associated with Engagement were identified within 21% ($n = 28$) of responses, which reaffirms the importance of the learner being actively involved with the material being presented. A typical sample of a response coded to this node is as follows:

> Being able to participate in activities that the product offers. For example, listen to music, play a game, view graphics and maybe even ask questions.

Such responses reinforce the need for designers to ensure that learners have access to relevant options and the importance of the learning environment being proactive by facilitating the learner's engagement with other participants and the learning resources (Sims *et al*., 2002).

The distribution of responses coded to Communication was characterized by terminology such as feedback, input-loops and two-way processes. Some responses also referenced particularly important terms such as "relationship" and "input," reinforcing the position or role the learner takes in the learning process and their ability to interact in an individual manner. At the same time, the other players in that process must also respond appropriately. The following is an example of a response coded to the Communication node:

> Interactivity means it must work both ways. Instead of the information simply being presented on the screen the user should be able to fiddle around, look at certain things in depth.

With respect to Control, 19% of responses ($n = 26$) were coded, where the majority of them focused on sub-themes such as choice, navigation and content. Overall, the responses emphasize a notion of freedom, where the user is able to make choices or choose learning directions depending on their particular requirements, especially those associated with access to content. However, an interesting issue arising from this relates to the instructional paradigm underlying the environment (Driscoll, 2000). If it is learner-centred, then this form of control may be consistent; however, if it is teacher-centred, then it is possible that set sequences or fixed discussion threads may be considered the best way for learning to be achieved. Balancing program and learner control so that both elements can be achieved is yet another challenge for the design and development of online, flexible learning. An exemplar of a response coded to this node is:

> Limiting the amount of information to be presented to the viewer and when the viewer is interested in a specific topic, they can zoom in and get more in-depth information.

Responses coded to Design represented 21% ($n = 28$), with the majority of the responses being grouped under the Flexibility sub-theme. The importance of the response distribution is that even though interactivity is primarily perceived as characterized by Control and Communication, the Design of an application will also play a major part in the implementation of interactive elements. Viewed from the design perspective specifically, this finding reinforces the need to undertake extensive analysis of the environment and interactive options prior to a design being implemented (Hedberg & Sims, 2001; Sims & Jones, 2002).

In summary, the second question was designed to elicit data that would develop a better understanding of interactivity by requesting participants to identify what they considered to be the major characteristics of interactivity. The dominant themes to emerge were Control, Communication, Engagement and Design and together they reinforce the complex inter-linking of factors that contribute to effective flexible learning environments, particularly those embracing online techniques (Sims *et al*., 2002). When considered in terms of the specific responses, participants' responses indicate that they have a clear expectation that interactive environments will provide them with control. Based on the responses provided by participants, users can expect to be able to operate in an environment that both enables an engaging

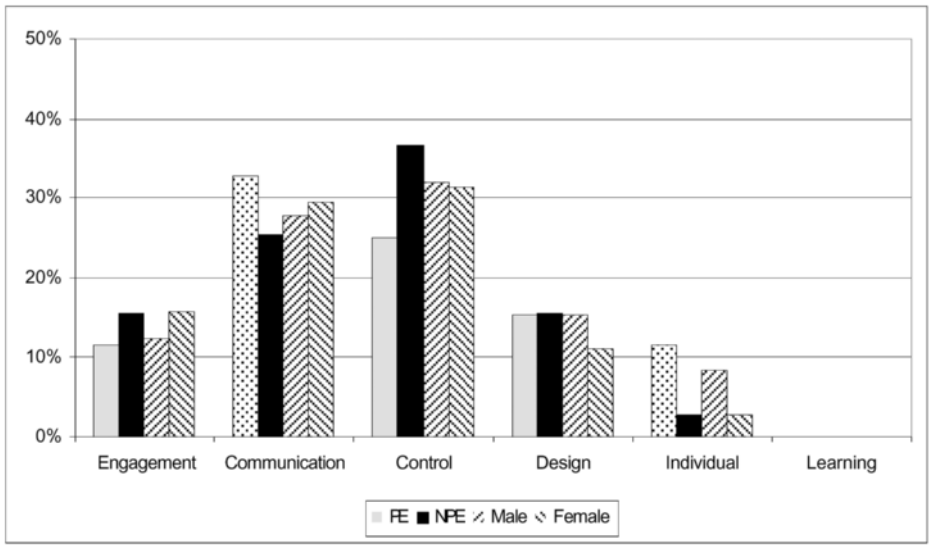

FIG. 6. Percentage of responses by experience and gender for Question 3.

experience with the interface responsible for at least some of the communication. The extent to which this is a function of the design process rather than the individual's ability to interpret an interactive environment is a critical question, as it is the ability of the user to work in a communicative relationship that appears to be an important expectation. This conclusion is not only confirmed by these particular responses but by the relationship with elements such as narrative (Plowman, 1996) and object manipulation (Aldrich *et al*., 1998).

What Makes an Educational Multimedia Product Interactive?

The identification of factors that contribute to interactive learning environments will help in understanding the extent to which the different conditions of interactivity are associated with their effectiveness. Figure 6 illustrates the coding distribution of responses by experience and gender, while Fig. 7 represents the coding distribution for all responses to this question.

When considered from the experience perspective (Fig. 7), those with more experience with interactive design and development (Group A) emphasize Communication over Control, Design and the Individual whereas those with less experience (Group B) emphasize Control over Communication. These variations suggest that those with more understanding or prior experience of the field of interactivity perceive the important aspects of interactivity as being those where there is more involvement or communication as well as a focus on the individual learner.

While there was little gender variation in the responses, the higher frequency of responses coded as Control (the user expecting to be able to perform certain activities) and Communication (the user expecting that the environment will be responsive in some manner) indicates the relative importance of these factors.

According to Aldrich *et al*. (1998), the ability to manipulate aspects of the learning environment and take an active and involved role in the learning process are critical aspects

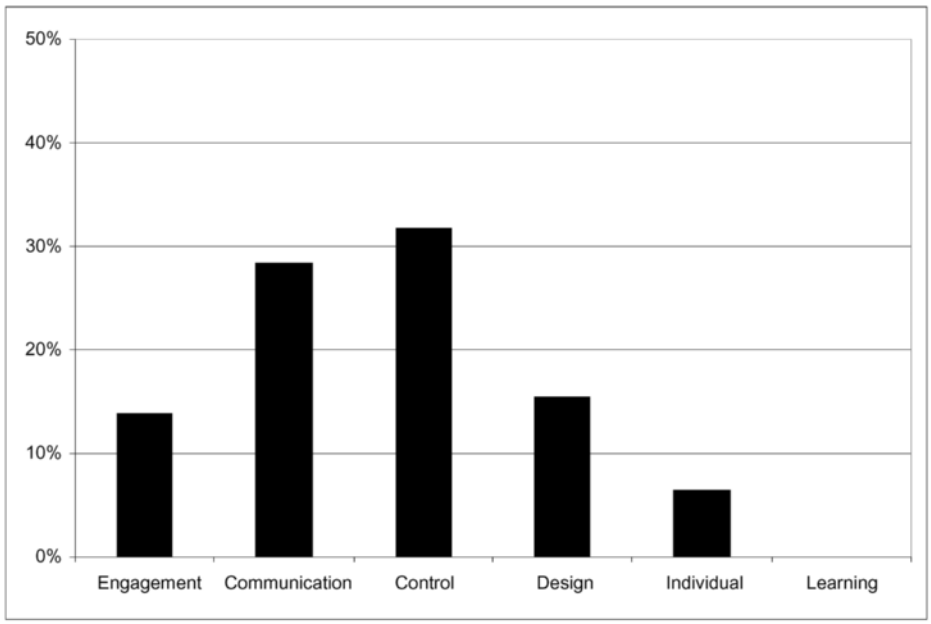

FIG. 7. Percentage of responses coded to nodes for Question 3.

of interactivity, and are consistent with both the mutual (Schwier & Misanchuk, 1993) and non-immersive (Sims, 1997) levels of interactivity. With this level of involvement the user can become engaged with other participants or the content material, focusing their attention on the learning and working towards deep learning (Craik & Lockhart, 1972). As illustrated in Fig. 7, (15% or $n = 17$) of responses were coded to the Engagement node for this question, and related to sub-themes such as Participation, Attention, Manipulation and Motivation. This suggests that for online and flexible learning environments to be effectively interactive, the learner is expected to be playing an active role which links to elements such as narrative (Plowman, 1996), theatre (Laurel, 1991) and encounters (Hedberg & Sims, 2001). With respect to the sub-theme of Attention, there is a need to place emphasis on the learning environment and providing the user with engaging activities. Consequently, it is therefore also imperative to remind the design team to create the appropriate interactive opportunities necessary to achieve this.

Another sub-theme coded to Engagement was that of Manipulation, which is differentiated from control as it places emphasis on the user being able to structure and form the content according to their own requirements (Aldrich *et al.*, 1998). Interest and Exploration were also aspects of interactivity coded to Engagement, indicating that learners might expect the environment to be organized in such a way that they can explore and seek information or other participants, and consequently become more focused and involved in the learning activity.

Not surprisingly, a second major theme to emerge from the coding of responses was that of Communication. There was a very clear expectation that there should be a two-way flow of information between users. This emphasizes the emulation of human–human interaction in the learner–computer activities, and feedback is identified as one of the critical aspects of the

communication process, as it provides the user with information on interpretations of their actions. Exemplars of responses coded to this node include:

> The possibility of immediate response and therefore the potential for communication.

> Getting good feedback. Seeing something happen when you do something.

An issue to consider in designing for interactivity is therefore the extent to which a form of conversation takes place, and for online environments supported by learning management systems, the ways in which the environment is able to play an active role in that process. However, it is apparent from this set of responses that participants expected the environment to engage them in some form of dialogue. User input and feedback are integral components of such dialogue. A question to emerge from this is what constitutes communication during a user's encounter with an application; is it the mere presence of the content or other participants, or is it more explicit forms of user and computer activity? The importance of feedback to the learning process cannot be underestimated (Sims, 2003). The way in which feedback is employed to maintain ongoing communication confirms its criticality to the success of online and flexible learning environments.

During the analysis of responses to Question 3, a recurring theme of navigation, self-pacing, control and choices was identified in responses (32% and $n = 39$). As these relate to actions a user can undertake, they were allocated to the major node of Control. The extent to which the learner is *in control*, as distinct from being provided with control options, is another aspect of interactivity that appears to be critical to the overall effectiveness of learning, as illustrated by this response:

> This is determined by how much control the user has over the application. Low interactivity: forward and back button; high interactivity: user involvement.

In the same way that research has indicated Design to be a critical element to interactivity and the learning process, the percentage of responses allocated to this node (16% and $n = 19$) for this question reflects that importance. An output of successful design is the extent to which a participant has an individualized environment in which to work, and this is reflected in the responses that identified factors such as individualization and adaptation. However, this can become complex, depending on the way interactive options are constructed for the learner. For example, Misanchuk and Schwier (1992, p. 356) contend that "in the most basic structure—a linear one—all learners necessarily go through the same experiences." But while an external observer might witness learners working through a similar set of materials or communications, we cannot conclude that they have undergone the same learning experiences individually. Similarly, more complex structures where learners have more choices are from one perspective more individualized. However, if the user does not feel in control, those choices may be misguided or misdirected in terms of the underlying instructional framework and strategy. This highlights again that interactivity is not a simple dynamic, but is itself a complex interaction between the different constructs and factors which are inherent in a learning context.

Based on the responses to this question, the Control and Communication themes were identified as major contributors to interactivity in learner–content situations, with Design and Engagement identified to a lesser extent. While control has been identified as a significant component of successful learner–computer interaction and subject to considerable research

attention, the communication factors are less explicit in the literature. The extent to which this form of communication or conversation is embedded in the program reactions to learner actions is one that continues to require investigation.

Conclusion

What expectations do people have from interactivity in the context of online and flexible learning environments? Using a survey instrument, participants were asked to respond to three questions focusing on the benefits, characteristics and structure of interactivity. The results were analysed and allocated to themes (or nodes) using a qualitative research paradigm and were discussed in terms of their overall distribution as well as in relation to variations manifested as a result of the gender and prior experience of participants.

Based on their responses, participants were able to articulate concisely their expectations of what interactivity should offer in the context of online and flexible learning environments. Following the coding process, the responses were classified in terms of six major nodes—Engagement, Control, Communication, Design, the Individual and Learning, which were consistent with the conditions of interactivity (Anderson, 2002; Wagner, 1994). More importantly, these themes can be aligned with the five major areas that have informed our current understanding of interactivity: educational psychology, interactivity research, human–computer interaction, communication and design. As a concept, therefore, interactivity has a strong theoretical base and, through this study, has been identified as providing benefits to learning. The challenge for designers is to create learning environments that will manifest the conditions for effective interaction. For example, given the benefits of narrative identified by Plowman (1996), the potential of theatre and performance as projections of narrative (Laurel, 1991) may provide a means of enhancing learning opportunities. If interactive learning environments can be created where the learner takes on a more participatory role and becomes an active player in a performance, then the interactive constructs may better match the expectations of the user.

The node hierarchy describing the categorization of responses was also considered with respect to variations between both gender and experience. While there was little variation in gender on expectations of interactive structure or characteristics, when examined in terms of benefits to learning there were more marked differences between the responses from male and female participants. The way in which the responses were coded suggests that the priorities of learners with respect to interactive constructs might vary based on their gender, indicating a need for further research in this area. This may also be true for other variables such as culture, which was not addressed in the current study. With respect to the prior experience of participants, the responses showed a degree of variation, and the distributions are consistent with research on learner control that has indicated that increased control becomes more useful as the user's experience increases (e.g., Alessi & Trollip, 2001). People with different levels of experience may expect different forms of interactivity to support their learning.

As has been emphasized in the presentation and analysis of the survey responses, these variations between groups suggest that the characteristics of the individual learner are essential determinants of the success of interactive, computer-enhanced learning environments. Creating opportunities that are more flexible and adaptable to the characteristics and preferences of the individual user is therefore paramount. While presentation of content is clearly one important aspect of any learning encounter, without effective interactivity manifested through communi-

cation, involvement, control and adaptation, the effectiveness of online and flexible learning will be minimized.

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