DOCUMENT RESUME

ED 373 730 IR 016 740

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TITLE Authentic Activity as a Model for Appropriate Learning Activity: Implications for Design of Computer-Based Simulations.

PUB DATE 94

NOTE 8p.; In: Proceedings of Selected Research and Development Presentations at the 1994 National Convention of the Association for Educational Communications and Tec.....gy Sponsored by the Research and Theory Division (16th, Nashville, TN, February 16-20, 1994); see IR 016 784.

PUB TYPE Reports - Evaluative/Feasibility (142) -- Speeches/Conference Papers (150)

EDRS PRICE MF01/PC01 Plus Postage.

DESCRIPTORS Computer Assisted Instruction; *Computer Simulation; *Computer Software Development; Context Effect; Educational Theo ies; Elementary Secondary Education; Higher Education; *Instructional Design; Learning; Linking Agents; Models; Outcomes of Education; Problem Solving; *Student Projects; *Teaching Methods; Theory Practice Relationship; Values

IDENTIFIERS *Authenticity

ABSTRACT

Implications of using authentic activity as a model for appropriate learning activity are discussed, particularly in regard to the design of computer-based simulations and project-based learning activities. Mere provision of computer-based simulations and reality-centered projects does not ensure that a student will derive the benefits of in-context learning. Characteristics of real-life problem-solving tasks, such as ill-structured problems, complexity, and duration, must be incorporated. The cognitive apprenticeship framework provides the primary rationale for using authentic activity as a model for appropriate learning activities. Theory suggests that learning outcomes are maximized when fidelity and complexity are added progressively in the simulation. A useful way to regard authentic learning activity is to see it as a simulation in which instructional overlay is designed to support a related set of values, integrating ends with means. Design must support the learner in establishing a learning enterprise within the global task environment, and the learning situation must afford activities that can be transferred to the real environment. (Contains 29 references.) (SLD)

Title:

Authentic Activity as a Model for Appropriate Learning Activity: Implications for Design of Computer-Based Simulations

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It is an often stated conviction that producing transfer is the main job of education. Yet, an increasing body of research shows that the way knowledge is presented to students in school and the kinds of operations they are asked to perform often result in students knowing something but failing to use it when relevant. Brown, Collins, and Duguid (1989) have concluded that this condition, variously referred to as a transfer problem or the problem of inert knowledge, occurs because classroom activities lack the contextual features of real-life problem-solving situations.

Today, there is widespread interest in learning through authentic use as the theory base for situated learning matures and as innovations in computer-based multi-media systems outstrip development of theory-based instructional strategies (Dick, 1991). Increasingly, theorists and educators are promoting reality-centered projects, theme-based learning, and other kinds of activities situated in real-life and life-like contexts as ways to engage students in meaningful learning (Blumenfeld, Soloway, Marx, Krajcik, Guzdial, & Palincsar, 1991; Clinchy, 1989; Wager, 1994). At the same time, the availability of powerful low-cost computers has stimulated interest in the design and development of simulations. Simulations have long been used to deliver instruction in educational, military, and industrial settings on the basis that they increase the ability of participants to apply what they have learned in the classroom to the real-world or transfer situation.

In this paper, we discuss the implications of authentic activity considered as a model for appropriate learning activity, particularly in the design of computer-based simulations and project-based learning activities. We suggest that there is much more to transforming the conventional classroom into an authentic learning environment than incorporating features of real-life situations into school work. The provision of computer-based simulations and reality-centered projects does not insure that a student will assume a positive orientation to learning nor derive the benefits of in-context learning. Much additional support is required to strengthen the tendency of the learner to engage in intentional learning processes and to help the learner progressively assume responsibility for learning.

The following discussion is divided into three sections, with each section organized around one of three questions and each question serving as a heading for one of the sections:
(a) What are the characteristics of real life problem-solving situations, and what is different about problem solving in school?
(b) What are the characteristics of educational simulations, and what do people learn from them?
(c) What are the characteristics of an authentic learning activity,
and how is it related to problem-solving in real life and simulated situations?

Question 1. What are the characteristics of real-life problem-solving situations, and what is different about problem solving in school?

In the cognitive apprenticeship framework, understanding develops through application and manipulation of knowledge within the context of the ordinary practices of the target culture--in other words, through authentic activity. This principle represents the primary rationale for using authentic activity as the model for appropriate learning activities. As Brown et al. (1989) suggested, conventional classroom tasks frequently lack the contextual features that support transfer from the school setting to the outside world. For advocates of ituated approaches to learning, the provision of authentic activity in schools is a way to increase cognitive engagement, support meaningful learning, and facilitate transfer.

In this section, we list characteristics of real-life problem-solving tasks that are relevant to the design of authentic learning environments:

• Conditions are frequently ill-structured and problems are ill-formulated. Hence, as Spiro, Feltovich, Jacobson, & Coulson, (1991) suggested, understanding develops through experience in multiple case contexts and from multiple perspectives within the same context.

• Practice using skills is embedded in performing the activities that justify developing the skills in the first place (Brophy & Alleman, 1991).

• The reasons for learning something or performing an activity are clear. Individuals assume responsibility for establishing and monitoring their goals and strategies when the reasons for performing procedures, even tedious ones, are understood within the context of a broad global task environment (Honebein, Duffy, and Fishman, 1994).

• Projects frequently have depth, complexity, and duration (Berliner, 1992). People have opportunities to engage in active and generative problem-solving activities that involve personal values and beliefs. As a result, they experience a feeling of ownership over the activity and its goals, and thus, the tendency to engage in intentional and self-regulated learning processes is enhanced.

• People work together in situations where the intelligence to solve a problem or perform an activity is distributed across a group of peers, a learner-mentor system, and/or an electronic performance support tool (EPSS) or other form of cognitive technology (Pea, 1993). The quality of interactions between participants is frequently of primary importance in undertaking a project or accomplishing a goal.

• People work on solving problems that do not already have known solutions. When people work collaboratively on solving real-life problems, they share in substantive conversation, which has a different quality from conventional school talk (Newmann, 1991). An individual's orientation toward learning is qualitatively different when learning is embedded in the context of achieving personally relevant and valued goals versus working for a grade or some goal that is far off in the future.

Question 2. What are the characteristics of an educational simulation, and what do people learn from them?

The theoretical assumptions underlying the design of simulations are varied, as are the purposes for which they are used and the contexts in which they appear. According to Cunningham (1984), a simulation duplicates some essential aspect of reality for purposes of experimentation, prediction, evaluation, or learning. An educational simulation is designed to increase one's ability to respond appropriately in a real-world or transfer setting. Participants practice decision-making, problem solving, and/or role playing in the context of a controlled representation of a real situation (Smith, 1986).

From an instructional design perspective, educational simulations support predetermined learning outcomes by providing participants with opportunities to deal with the consequences of their actions and to respond to feedback. Within Pea's (1985) framework of distributed intelligence, computer-assisted simulations have the potential to reorganize mental processes by "closing of the temporal gaps between thought and action [and] between hypothesis and experiment" (p. 85). Pea has proposed that by allowing the user to engage in "what-if thinking" through a partnership between user and technology, deep qualitative effects are made possible on how problem solving occurs.

In reviewing the literature on simulation, the definition of fidelity appears to vary depending on the context to which it is applied and the theoretical orientation of the author. For example, in proposing a model for assessing the fidelity of task simulators used in industry, Bruce (1987) proposed three criteria: (a) physical similarity, (b) functional similarity, and (c) task communality. The fidelity of a simulator within Bruce's fidelity

verification model is determined by assigning a value to each of these categories and combining them to produce a fidelity index for a particular training device. In contrast, Smith (1986) believes that the essential reality factor in a simulation is not the form of the simulation but the information-processing demands it imposes on the learner. He has referred to this characteristic of a simulation as its "cognitive realism," the degree to which the simulation engages participants in a decision-making or problem-solving process that parallels the mental activities required in the real situation.

Contrary to what intuitively may seem the case, research does not support the idea that maximizing realism or fidelity of a simulation results in maximizing learning outcomes (Alessi, 1987). With this in mind, Reigeluth and Schwartz (1989) have recommended that the best way to handle complexity in a simulation, when designing for a novice learner, is to start with low fidelity and to add fidelity and complexity progressively. Similarly, Blumenfeld et al. (1991) have proposed that a great strength of simulation for instructional purposes is its potential to allow students active exploration in simplified environments. They believe that when extraneous details are minimized, interactions between variables are easier to notice than in a highly realistic simulation or in the transfer environment itself.

Reigeluth and Schwartz (1989) have described three major elements in the design of a simulation that they believe determine its effectiveness: the scenario, the underlying model, and the instructional overlay. They have suggested that the scenario (the situation and the learner interface with the simulation) and the model (usually a mathematical formula in computer-based simulations for establishing causal relationships but can be some other basis) should duplicate to some degree the essential characteristics of the transfer situation. In other words, the characteristics of the scenario and the model determine the fidelity of the simulation, although how to identify the essential characteristics of the transfer situation is not addressed. Reigeluth and Schwartz have concluded, on the basis of their own analysis of simulations, that the instructional overlay (the features in the simulation that function to optimize learning and motivation) are generally the weakest aspect in educational simulations.

One element of the instructional overlay that Reigeluth and Schwartz (1989) feel should receive more attention from designers is the provision of artificial feedback. Alessi and Trollip (1985) have distinguished between natural feedback that the real-life situation provides, and artificial feedback that the designer builds into the simulation. One of the strengths of simulation for instructional purposes is its potential to shelter learners from costly forms of natural feedback (skidding into a snow bank) and to provide real-time artificial feedback (turn in the direction of the skid.)

The simplifying conditions method proposed by Reigeluth (1993) appears to take advantage of strengths inherent in simulation without sacrificing authenticity of the learning activity. In this method, experts identify a simple kind of case that is as representative as possible of a real-world task and the ways in which this "epitome" version of the task differs from more complex versions. Over time, complexity and variation are added to the learning activity in a systematic manner with the expectation that the method preserves the potential benefits of in-context learning. Reigeluth has claimed that this is a more holistic way to sequence instruction than the traditional parts-to-hole approach and is compatible with context-based design models. In the following section, we will return to this and other issues previously raised when we discuss what we see as the similarities and differences between real-life situations, simulations, and authentic learning activity.

Question 3. What are the characteristics of an authentic learning activity, and how is it related to problem-solving in real life and simulated situations?

Buchanan (1992) has suggested that since conditions are ill-structured and problems are ill-formulated in many areas of human endeavor, all but the most clearly linear design problems assume a fundamental indeterminacy. von Bertalanffy's (1967) distinction between open as opposed to closed systems is relevant to this view. He has written that closed systems such as cybernetic or feedback systems are open to information but do not exchange matter with the environment. Open systems, on the other hand, such as organisms and other living systems are maintained in a continuous exchange of components. Instructional design within an open systems framework requires a shift in preferred metaphor for education from transmission of information to building representations of meaning.

From a constructivist perspective, the most pertinent issue facing designers is what educational goals are worthwhile. Authentic activity represents a holistic and generative view of appropriate learning activity that treats learning and motivation as interdependent processes and places emphasis on self-directed learning and on development of metacognitive ability necessary to support it. Authentic learning situations retain some of the complexity and messiness of real-world problem-solving situations, as well as some of the advantages of simulation discussed previously.

One way to think about authentic learning activity is as a simulation where the instructional overlay is designed to support a related set of values: collaboration, autonomy, multiple perspectives, pluralism, activity, reflectivity, generativity, authenticity, and ownership (Lebow, 1993). In this view of instruction, ends are integrated with means. For example, a goal of instruction, to develop interpersonal skills for sustaining cooperative group work, is also a means to achieving the very same goal by practicing group process skills in the context of personally relevant goals. Another goal, to develop the ability to reflect on one's own learning processes, is also a means to self-correction and self-regulation of the learning process. In effect, instruction within an authentic learning activity is a model for the values that instruction is designed to support.

Carroll (1990) has suggested that in order to facilitate transfer, promote metacognitive and affective learning, support an adaptive motivational pattern to learning and encourage a high degree of ownership and personal relevance, educators should provide training on real tasks. Similarly, Spiro, Vispoel, Schmitz, Samarapungavan, and Boeger (1987) believe that "cases and examples must be studied as they really occur, in their natural contexts, not as stripped down 'textbook examples' that conveniently illustrate some principle" (p. 181). Honebein et al. (1994) have concluded that understanding developed in a simplified environment is different from understanding in the transfer environment. They have argued that the complexity of the learning environment in the early stages of learning should reflect the complexity of the authentic context to the extent practical. Otherwise, when instructional designers simplify the learning environment, they may unwittingly alter the metacognitive and affective demands of the authentic task complex. From this perspective, the role of instruction changes from controlling student learning through imposing a simplifying structure on the environment to developing new strategies, tools, and resources that support the student in functioning within the authentic learning context.

Our understanding of authentic activity as a model for appropriate learning activity is somewhat different than the one expressed above. We see authentic activity as involving a more complex view of fidelity than simply a concern for optimizing the degree of realism and the level of complexity in a learning situation. Anderson (1990) has suggested that if we want to explain human behavior, we should seek understanding in the individual's assumptions about the environment and in the information-processing demands that the environment imposes. On this basis, the optimal degree of fidelity and complexity required in a simulation to effectively transfer new learning is determined by the affordances of the environment and the frame of reference of the learner. What matters most is not the

realism of the simulation or the processing level of the learner, but whether the learner practices what is essential for the transfer situation. Thus, a good test is also a good learning activity and instruction and assessment are inseparable within an authentic learning environment (Snow & Mandinach, 1991).

A fundamental principle of instructional design that follows from an open systems view is that the orientation of the individual to learning is part of the context. For example, students often study so as to produce the outcome that they expect the teacher to assess (Schmeck, 1988). When authentic activity is the model for learning activity, the meaning that the individual attributes to learning, including expectations, attitudes, and beliefs, is a focus for the design effort. From a post-modern perspective, the individual's perceptions have value and represent a basis for mutual inquiry rather than an obstacle to be maneuvered around (Doll, 1989; Gough, 1989).

In summary, when authentic activity is the model for appropriate learning activity, the perceptions of the learner and the affordances of the environment represent an integral and inseparable context of learner/environment. The implications for instruction are primarily twofold: design must support the learner in establishing a learning enterprise within the larger global task environment, and the learning situation must afford the kinds of activities that are essential for success in the transfer environment.

References

Alessi, S. (1987, April). Fidelity in the design of instructional simulations. Paper presented at the Annual Meeting of the American Educational Research Association, Washington, D.C.

Alessi, S. & Trollip, S. (1985). Computer based instructior . Methods and development. New York: Prentice Hall.

Anderson, J. R. (1990). The adaptive character of thought. Hillsdale, NJ: Lawrence Erlbaum.

Berliner, D. C. (1992). Redesigning classroom activities for the future. Educational Technology, 10, 7-13.

Blumenfeld, P. C., Soloway, E., Marx, R. W., Krajcik, J. S., Guzdial, M., & Palincsar, A. (1991). Motivating project-based learning: Sustaining the do supporting the learning. Educational Psychologist, 26(3 & 4), 369-398.

Brophy, J. & Alleman, J. (1991). Activities as instructional tools: A framework for analysis and evaluation. Educational Researcher, 20(4), 9-23.

Brown, J. S., Collins, A., & Duguid, P. (1989). Situated cognition and the culture of learning. Educational Researcher, 18(1), 32-42.

Bruce, R. C. (1987). Simulation fidelity: A rational process for its identification and implementation. Unpublished manuscript.

Buchanan, R. (1992). Wicked problems in design thinking. Design Issues, 8(2), 5-21.

Carroll, J. M. (1990). The Nurnberg funnel: Designing minimalist instruction for practical computer skill. Cambridge, MA: MIT Press.

Clinchy, E. (1989). Education in and about the real world. Equity and Choice, 3, 19-29.

Cunningham, J. B. (1984). Assumptions underlying the use of different types of simulations. Simulations and Games, 15(2), 213-234.

Dick, W. (1991). An instructional designer's view of constructivism. Educational Technology, 5, 41-44.

Doll, D. E. (1989). Foundations for a post-modern curriculum. Journal of Curriculum Studies, 21(3), 243-253.

Gough, N. (1989). From epistemology to ecopolitics: Renewing a paradigm for curriculum, Journal of Curriculum Studies. 21(3), 225-241.

Honebein, P. C., Duffy, T. M., & Fishman, B. J. (1994). Constructivism and the design of learning environments: Context and authentic activities for learning. In T. M. Duffy, J. Lowyck, & D. Jonassen (Eds.), Designing environments for constructivist learning. Hillsdale, NJ: Lawrence Erlbaum.

Lebow, D. G. (1993). Constructivist values for instructional systems design: Five principles toward a new mindset. Educational Technology, Research, & Development, 41(3), 4-16.

Newmann F. M. (1991). Linking restructuring to authentic student achievement. Phi Delta Kappan, 2, 458-463.

Pea, R. D. (1985). Beyond amplification: Using computers to reorganize mental functioning. Educational Psychologist, 20(4), 167-182.

Pea, R. D. (1993). Practices for distributed intelligence and designs for education. In G. Salomon (Ed.), Distributed cognitions: Psychological and educational considerations (pp. 47-87).

Reigeluth, C. M. (1992). Elaborating the elaboration theory. Educational Technology, Research, & Development, 40(3), 80-86.

Reigeluth, C. M. and Schwartz E. (1989). An instructional theory for the design of computer-based simulations. Journal of Computer-Based Instruction, 16(1), 1-10.

Schmeck, R. (1988). Strategies and styles of learning: An integration of varied perspectives. In R. Schmeck (Ed.), Learning strategies and learning styles (pp. 317-346). New York: Plenum

Smith, P. (1986). Instructional simulation: Research, theory and a case study. (ERIC Document Reproduction Service No. ED 267 793)

Snow, R. E. & Mandinach, E. B. (1991). Integrating assessment and instruction: A research and development agenda. (Research Report RR-91-8), Princeton, NJ: ETS.

Spiro, J. R., Vispoel, W., Schmitz, J., Samarapungavan, A. & Boerger, A. (1987). Knowledge acquisition for application: Cognitive flexibility and transfer in complex content domains. In B.C. Britton (Ed.), Executive control processes (pp. 177-199). Hillsdale, NJ: Erlbaum.

Spiro, R. J., Feltovich, P. J., Jacobson, M. J., & Coulson, R. L. (1991). Cognitive flexibility, constructivism, and hypertext: Random access instruction for advanced knowledge acquisition in ill-structured domains. Educational Technology, 31(5), 24- 33.

von Bertalanffy, L. (1967). Robots, men, and minds. New York: George Braziller.

Wager, W. W. (1994). Designing thematic units and integrated learning activities. Paper presented at the annual convention of the AECT (Nashville, TN, February 14-19).