Developments in Business Simulation & Experiential Learning, Volume 27, 2000

COLLABORATIVE LEARNING AND WEB-BASED INSTRUCTION IN A COGNITIVE APPRENTICESHIP MODEL

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ABSTRACT

A study was conducted to determine the effects of collaborative learning and web-based instruction on academic achievement, in a constructivist environment in a principles of financial accounting course. The instructional module used in the study was implemented in the form of a cognitive apprenticeship and incorporated situated learning tenets. A two-by-two factorial research design was employed. An evaluation of study results indicated that neither collaborative learning nor web-based-instruction alone impacted students posttest performance. However, an evaluation of the interaction effect indicated that: collaborative learning was more effective when students were instructed in a classroom setting and utilized traditional, face-to-face collaborative methods; and web-based instruction was more effective when students worked individually rather than in collaborative dyads.

CONSTRUCTIVIST LEARNING THEORY

Learning theory has evolved into three paradigms: behaviorism, cognitivism, and constructivism. The basic difference between these paradigms is the consideration of objective reality verses relative reality and external environments versus internal processes. Behaviorism characterizes knowledge as object reality and learners as passive vessels into which knowledge can be placed (Driscoll, 1994). Behaviorism is criticized because knowledge is often disconnected from complex, realistic contexts and fragmented into manageable chunks (Slavin 1991). Cognitivism focuses on mental operations and the role of the mind in gaining knowledge. Cognitivists tend to view knowledge as largely objective in nature, yet as something developed through internal processes (Driscoll, 1994; Slavin, 1991). Constructivism is essentially an extension of cognitivism. Constructivists emphasize three major points with regard to learning: knowledge is not object reality but is experienced reality, knowledge is situation-bound or context-dependent, and knowledge is not passively received but actively constructed (Driscoll, 1994; Pascual-Leone & Irwin, 1998).

Proponents of constructivism argue that knowledge is based on learners' individual perceptions and experiences. As a consequence, pertinent learning experiences are vitally important for learners to construct knowledge. Since knowledge construction is situation-bound, realistic situations and authentic tasks aid learners in development of relevant skills and enhance learners' motivation (Cognition and Technology Group at Vanderbilt, 1990). The learner must ultimately understand the how, when, what, and why of information concepts and relationships. Constructivists argue that through purposeful manipulation, careful observation, and thoughtful analysis learners can develop a deep insight and understanding of the subject matter at hand.

Cognitive psychologists, such as Resnick (1976), have underscored a troubling feature of typical classroom learning: its decontextualized character. In authentic contexts, learning gets support in a number of ways absent in the typical classroom. In authentic contexts: apprentice-like relationships are common; relevant knowledge and skills figure conspicuously in making progress on tasks; tasks allow learners to establish meaningful representations and connections within the knowledge domain; instruction is situated in engaging, problem-rich environments; and a social network func-

tions to support and sustain performance.

As an alternative to traditional instruction, many cognitive scientists advocate the centuries-old apprenticeship framework as the way to integrate the teaching of authentic, meaningful tasks (Teslow, Carlson, & Miller, 1994). They suggest that humans seem to learn naturally through enculturation, the imitation of the behavior of a social group in accordance with its norms. In most professions, entry-level professionals are indoctrinated into the culture of the profession and aided in the development of appropriate knowledge, skills, and judgment, through coaching, modeling, or mentoring. Enculturation can be enhanced by designing cognitive apprenticeships around authentic tasks and realistic performance, using tools-of-the-trade, and encouraging collaboration in realistic, information-rich environments (Teslow, Carlson, & Miller, 1994). "Truly effective learning should be situated in a culture of needs and practices that gives the knowledge and skill being learned context, texture, and motivation" (Perkins, 1995, p. 68).

THE STUDY

Sampling, Participants, and Instructional Materials

The study employed a combination of convenience sampling and random assignment. Students in three daytime sections of ACG2021 Principles of Financial Accounting were combined to establish a single participant pool, containing 91 participants. Participants were randomly assigned from the participant pool to one of four treatment groups: web-based, collaborative learning; non-web-based, collaborative learning; web-based, individualized learning; and non-web-based, individualized learning. The collaborative learning groups involved the use of learning dyads--pairs of learners.

Instructional materials used in the study constituted a researcher-developed module of instruction related to the topic of fixed asset accounting. A constructivist scenario depicted the fictional exploits of Chris Torrez, during Chris initial day as a co-operative education student. Chris was co-oping with Pensa Cola, Incorporated (PCI), a regional soft drink developer and distributor. As Chris moved through the day he/she was exposed to the relevant issues, decisions, and activities that relate to the topic of fixed asset accounting.

Chris Torrez, the central character in the instructional scenario, represented a gender neutral student of possible minority ethnic background. Other individuals, objects, and events in each of the various scenes within the scenario were described and/or displayed (graphically) from Chris perspective; Chris, however, was not shown. The instructional approach selected represented an attempt to allow each student utilizing the instruction to take on the persona of Chris, in order to cognitively enter the environment described and participate in the events depicted.

The web-based instruction was delivered via WebCT. WebCT is course management software that can be used to design and implement entire online courses or to supplement traditional course offerings. WebCT uses the Internet and the World Wide Web (WWW) as delivery mechanisms and uses Web browser software as an interface environment.

Variables

The study included: two independent variables, collaborative learning and web-based instruction; a control variable, preexisting knowledge; and the dependent variable, posttest performance. Individual learners scores were used to establish their level of pretest and posttest performance, while the mean score of the two dyad members was used to establish the dyad s dimension with respect to the variables.

The independent variable collaborative learning was comprised of two levels: collaborative learning, in the form of structured dyads; and individu-

alized learning. The dyads were structured in that the researcher required that a limited number of specific activities take place during the collaborative effort. The collaboration was not scripted, however. While the definition and characteristics of collaborative learning are not clearly delineated (Butler, 1999; Markulis, Strang, Gosenpud, & Wheatley, 1994; Ramey, Leonard, & Leonard, 1999), the study's collaborative learning environment was configured to provide for: positive interdependence, in the form of means interdependence via assignments structured so that in order for one group member to complete his/her tasks, the other group member must complete his/her tasks; group and individual accountability, by assigning both a group and individual grade for the homework assignments; promotive interaction, by requiring partners to exchange information and materials and provide each other with feedback; and interpersonal skills, by requiring learners to participate in dyadic collaborative assignments prior to the study.

The independent variable web-based instruction was comprised of the two levels web-based instruction and non-web-based instruction. The web-based instruction involved use of instructional material that was available via the WWW, and utilization of Internet and web-based communication tools for learner collaboration and student-teacher interaction. Learners in the web-based treatment groups did not attend class meetings during the treatment period. The non-web-based instruction took the form of traditional on-site classroom instruction, and involved the use of printed-based instructional material, and traditional face-to-face collaborative methods.

The control variable preexisting knowledge represented the extent to which the learner was already familiar with basic fixed asset accounting concepts and principles. Preexisting knowledge was measured via a pretest administration of the study's posttest instrument and served as a covariate with respect to posttest performance.

Posttest performance was used to establish learners' level of academic achievement. Posttest performance also represented the extent to which learners demonstrated mastery of instructional objectives related to the selected topic content. Utilizing a grading scale of 0 to 100, posttest performance was established via a measure of the degree to which learners correctly responded to questions and a problem on a discipline-oriented, researcher-developed examination. An expert panel confirmed the posttest instrument's content validity; Formula K-R 20 and inter-rater reliability procedures established the instrument's reliability.

Procedures

Following administration of the pretest and an orientation session, study participants, individually or collaboratively, used the web-based or hard-copy instruction and completed the prescribed related exercises, assignments, and activities. Access to the online instructional materials was limited, via WebCT access features, to only those participants assigned to the web-based learning groups. Because of the constructivist nature of the instruction, classroom instruction during the research study did not take the form of a traditional lecture-oriented presentation. The instructor/researcher functioned primarily as a discussion guide and moderator, and served as a source of information, not a conveyor of information. During the study, the instructor/researcher remained available to all students to the same extent that the instructor was available to students prior to initiation of the study (in person during regularly scheduled office hours and via telephone or e-mail). The posttest was administered following completion of research study activities.

Research Design and Data Analysis

The study employed a pretest-posttest factorial (2x2) design, with randomization. Factorial designs are modifications of the posttest-only control group or pretest-posttest control group de-

signs, and they allow for the investigation of multiple independent variables and the evaluation of interactions between variables (Fraenkel & Wallen, 1996).

The effect of ANCOVA is to make two or more groups equal with respect to control variables (Gall, Borg, & Gall, 1996). Therefore, an ANCOVA was used to evaluate data, assessing for significance at the .05 significance level.

RESULTS AND DISCUSSION

Collaborative Learning

The initial evaluation of study data examined the main effect of the independent variable collaborative learning. A comparison of the adjusted means suggested that while learners in the collaborative learning environment (M = 77.16, SD = 11.99) performed at a somewhat higher level of academic achievement than did learners in the individualized learning environment (M = 76.98, SD = 13.79), the difference in performance levels was not statistically significant.

Slavin (1990) maintains that the primary advantage of collaborative learning is enhanced academic achievement, and there is wide agreement among researchers that collaborative learning methods can and do generally have a positive effect on academic achievement. However, Slavin's (1995) recent synthesis of best evidence related to collaborative learning indicates that 31% of the studies reviewed found no significant difference in achievement level, while 5% of the studies determined a significantly negative effect on achievement. This study□s findings concur with the findings of the approximately 1/3 of collaborative learning studies that suggest that collaborative learning does not significantly increase academic achievement. In addition, the results of this study are in line with those of earlier collaborative learning studies in the area of accounting, which generally did not indicate enhanced academic achievement (Cottell, 1991; Hite, 1996; Parry, 1990; Ravenscroft, Buckless, McCombs, & Zuckerman, 1995).

Web-based Instruction

A subsequent evaluation of study data examined the main effect of the variable web-based instruction. A comparison of the adjusted means suggested that learners in the web-based learning environment (M=75.62, SD=13.53) demonstrated slightly lower level of academic achievement than did learners in the non-web-based learning environment (M=78.52, SD=12.09). Again, the difference in adjusted means was not statistically significant.

Contrasting this study□s results with similar studies proved to be difficult in that the body of documented research related to web-based instructional environments is just beginning to be established. The issue of technology□s impact on learning has been debated for some time, however. Clark's (1983) contentious meta-analysis of instructional systems led him to conclude that technologies "do not influence learning under any circumstance" (p. 445). Clark (1983, 1994) argues that technology can impact only the cost or extent of disseminating instruction, and that it is the quality of the instruction itself that impacts learning. In contrast, Kozma (1991) contends that the characteristics and capabilities of a particular technology "interact with and influence the ways learners represent and process information and may result in more or different learning. . ." (p. 179). From the perspective of the overall effect of learning environment, the results of this study lend further credence to Clark□s contention. The instruction utilized did not impact academic achievement more substantially in the web-based environment than it did in the non-web-based environment.

Interaction of Collaborative Learning and Web-based Instruction

The final evaluation of study data examined the interaction effect of the two independent variables collaborative learning and web-based instruction. A comparison of adjusted mean scores suggested that learners in the non-web-based, collaborative learning environment ($M = 83.61$, $SD = 7.69$) performed at the highest level of academic achievement, followed by learners in the web-based, individualized learning environment ($M = 80.52$, $SD = 13.26$), then by learners in the non-web-based, individualized learning environment ($M = 73.43$, $SD = 12.78$). Learners in the web-based, collaborative learning environment ($M = 70.71$, $SD = 12.04$) demonstrated the lowest level of academic achievement. The results of ANCOVA procedures indicated that the interaction effect was statistically significant and was disordinal.

When the interaction of two independent variables is disordinal, the preferable treatment level for one factor depends upon the particular level of the other factor. In this case, participants utilizing collaborative learning demonstrated higher academic achievement in the non-web-based learning environment than in the web-based learning environment, while participants utilizing individualized learning demonstrated higher academic achievement in the web-based learning environment than in the non-web-based learning environment. Likewise, participants utilizing web-based instruction demonstrated higher academic achievement in the individualized learning environment than in the collaborative learning environment, while participants utilizing non-web-based instruction demonstrated higher academic achievement in the collaborative learning environment than in the individualized learning environment.

Based on a review of the literature, the researcher had anticipated that achievement-oriented benefits would accrue to those learners who participated in collaborative learning and to those learners who utilized web-based instruction. It seemed logical to assume that optimum benefits would accrue to those learners who were exposed to both collaborative learning and web-based instruction. While the study did not formally incorporate a control group, the factorial group that was not exposed to either one the treatment conditions served to establish a baseline performance level. Learners in the non-web-based, collaborative environment and learners in the web-based, individualized environment demonstrated commensurate and enhanced levels of academic achievement, as expected. However, learners in the web-based, collaborative environment performed at a level of academic achievement comparable to learners in the non-web-based, individualized environment. In other words, learners in the factorial treatment group that should have demonstrated the highest level of performance actually demonstrated the same level of achievement as learners in the baseline group.

IMPLICATIONS

Based on results from collaborative learning studies in other disciplines and the recommendations of the AAA (1986), AECC (1990), IMA and FEI (1994) and the accounting profession, accounting educators have begun integrating collaborative learning into accounting courses. While web-based collaboration did not increase academic achievement, it is critical that accounting instructors begin to utilize Internet-based collaborative activities. Accounting and business students stand to benefit both educationally and professionally from early exposure to distributed technologies. "After IT [Information Technology] specialists, accountants are the most computer literate professionals" (Olivier, 1995, p. 8). The Internet embodies a new interface between accountants, information users, and organizations. "Students of business read about collaboration, information technology, virtual organizations, and virtual products, but do not participate in their creation until after graduation" (Roy, 1997, p. 2). As students become more familiar with and adept at distributed collaboration, it seems logical that increased

academic achievement would then follow.

Current, traditional, place-based educational models are expensive and cannot meet the rising demand for educational services. Colleges and universities are considering whether to maintain or to enlarge classroom-based academic programs or to substitute electronic programs, which they believe may offer a variety of economies (The IHEP, 1999). The body of research related to distance education, which higher education institutions must draw upon when making such decisions, is limited. In particular, web-based instruction is new enough that researchers are just now beginning to report the effects of web-based instruction on academic achievement and other issues. This study□s results support Kozma□s (1991, 1994) argument that technology□s impact on learning is a function of the particular learning situation, the tasks undertaken, and the learners involved. Study results indicated that the achievement effect of web-based instruction was impacted by the other instructional tactics employed and the ability of learners to effectively discharge the related imperatives.

Because individualized learners appeared to benefit from web-based instruction, instructional designers and developers can focus on supporting individual learning styles and preferences within a web-based environment, comfortable that such instruction should prove to be as effective as traditional, classroom-based instruction. However, because web-based, collaborative participants did not appear to benefit from web-based instruction, instructional designers and developers who plan to incorporate collaborative activities into web-based instruction should consider that many learners may not be technically or psychologically prepared to effectively participate in such activities, and that the consequence may be a lack of student achievement. Instructors who utilize web-based instruction should recognize that not all learners will be equally prepared to participate in all forms of web-based instruction, and that achievement may be impacted. Learners who are considering taking a web-based course should consider their own skills and abilities in conjunction with the instructional approach and tactics employed (e.g., degree of online collaboration) when assessing the potential for attaining their desired level of achievement while taking the course. Lastly, colleges and universities must recognize that unless students are prepared to participate in technology-based collaborative efforts, increased access to instruction via web-based distance learning may result in reduced success and completion rates.

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