Learning Style and Preference for Online Learning Support: Individual Quizzes versus Study Groups

Genevieve Marie Johnson, PhD
Department of Psychology
Grant MacEwan College, Canada, johnsong@macewan.ca

Julia Ann Johnson, PhD
Department of Mathematics and Computer Science
Laurentian University, Canada, julia@cs.laurentian.ca

Abstract: Forty-eight college students participated in an ABAB analysis; the A condition was online study groups and the B condition was individual online quizzes. The effect of A and B on student satisfaction and achievement was determined. The Index of Learning Styles categorized students on four dimensions of learning style (active-reflective, visual-verbal, sequential-global, sensing-intuitive). Active learners expressed preference for face-to-face study groups rather than online study groups and for online quizzes rather than pencil-and-paper quizzes. Visual learners expressed preference for online quizzes rather than online study groups. Such preferences were validated by decreased achievement under the online study group condition. At the college level, students are aware of their learning style and the conditions that facilitate their learning.

Instructional applications of computer technology frequently augment college student in-class learning and purport to support achievement on in-class examinations (Crook, 2001; Grabe & Sigler, 2002; Shale, 2002). Practice tests and quizzes are popular forms of online support, reportedly helping students evaluate their learning and focus study effort accordingly (Fritz, 2003; Haberyan, 2003; Herring, 1999; Itoh & Hannon, 2002). Derouza and Fleming (2003) compared undergraduates who completed quizzes online with students who took traditional paper-and-pencil quizzes. Comparison of in-class examination marks revealed that students who took the quizzes online significantly outperformed students who took pencil-and-paper quizzes.

In addition to practice quizzes, online study groups are increasingly popular forms of support for student learning (Killedar, 2002; Tait & Mills, 2003). Crook (2002) suggested that "new technology may become a lever on what is otherwise a failure by students to take advantage of collaborative opportunities" (p. 66) and reported that when students were assigned to an online study group, "71% said that it was helpful or very helpful" (p. 75). Johnson and Johnson (2005) compared the relative effectiveness of two study strategies in online groups, reciprocal peer questions and mnemonic devices. While there was no significant difference in academic achievement between students in the two study conditions, "students in the reciprocal peer questioning group reported higher levels of satisfaction with the virtual study experience" (p. 2025).

Although online forms of learning support such as practice quizzes and study groups are commonly provided to students (Jensen, Johnson, & Johnson, 2002; Jensen, Moore, & Hatch, 2002; Miller & Lu, 2003), the benefits of such support are not consistently reported (Perlman, 2003). This may be the consequence of failure to consider individual student differences in relation to various forms of online learning support. Learning style is an important individual difference variable in traditional instructional contexts and may be of even greater consequence in online learning environments that often require complex combinations of sensory and cognitive processing (Subrahmanyam, Kraut, Greenfield, & Gross, 2001).

Learning Style and Online Instruction

Learning styles refer to "characteristic cognitive, affective, and psychological behaviours that serve as relatively stable indicators of how learners perceive, interact with, and respond to the learning environment" (Keffe, 1979, p. 4). "Each person's style is a combination of various biological and experiential variables that contribute to learning" (Rochford, 2003, p. 667). The impact of student learning style in online instructional environments is the target of research effort (Fahy & Ally, 2005). Aragon, Johnson, and Shaik (2002) concluded that although learning style differences were found between face-to-face and online students, "these differences were not significantly apparent when student success was controlled" (p. 243). Neurhauser (2002) compared two sections of the same course, one delivered asynchronously online and one delivered face-to-face. Reportedly, "there were no significant differences between learning preferences and styles and grades in either group" (p. 99). Stokes (2003) surveyed college students enrolled in courses that incorporated Web-based components in order to identify predictors of satisfaction with digital learning. She concluded that students "should be reassured that the environment is not restrictive in terms of … preferred learning styles" (p. 1).

To date, the research has focused on comparing learning style in face-to-face versus online environments. It is possible, however, that learning style differentially effects student interpretation of various online study tools. The current investigation sought to determinate the impact of learning style on college student satisfaction and achievement under two online instructional support conditions, individual quizzes and study groups. Does learning style predict student preference for face-to-face study groups rather than online study groups? Does learning style predict student preference for pencil-and-paper quizzes rather than online quizzes? Does learning style predict student satisfaction with one form of online learning support over the other? Most importantly, is there a relationship between student learning style, type of online learning support, and academic achievement?

Methods and Procedures

Subjects

Students in two sections (40 students per section) of an educational psychology course were required to participate in two forms of online learning support in preparation for four in-class proctored examinations. At the end of the academic term, student permission was obtained to use course marks for purposes of the investigation. As well, students who chose to participate completed a questionnaire that assessed learning style and preference for online learning support. Due to student withdrawal from the course as well as absenteeism on the day the questionnaire was administered, 48 students participated in the study. Students ranged in age from 18 to 33 years (mean 21.3 years). Approximately 77% of the sample was female which is characteristic of the student population in the participating college. Students reported an average of 32 college credits complete (range 0 to 120).

Online Learning Support

In preparation for the first and third in-class midterm examinations, students were required to make postings in online study groups using the WebCT discussion tool. In preparation for the second midterm and final in-class examinations, students were required to complete individual online quizzes using the WebCT quiz tool.

Online Study Groups

Students were randomly assigned to WebCT online study groups consisting of eight student-members. The course outline stated that study group postings were not restricted to but may include; study notes, chapter summaries, practice test items, questions for reflection, definitions and key terms, and specific mnemonics. Online study group

membership did not change throughout the academic term, although student withdrawal from the course altered group dynamics in some cases. Study groups opened two weeks prior to the examination and closed the day of the examination. Student postings were individually marked in terms of number of postings, quality of posted study strategy, and variety of study strategies posted. Online study group postings associated with the first midterm examination contributed 5% to the final course grade and postings associated with the third midterm examination contributed 10% to the final course grade. The mean student grade for postings associated with the first midterm examination was 82.5% (range 0 to 100%); the mean student grade for postings associated with third midterm examination was 80.5% (range 0 to 100%). Within the context of the educational psychology course, the online study groups served two functions; contributing 15% to the final course grade and helping students prepare for two in-class examinations.

Individual Online Quizzes

The online quizzes contained true-false and fill-in-the-blank items that corresponded to the content assessed on the second midterm examination and previously untested content assessed on the final examination (i.e., the final examination was cumulative but online quizzes did not support review of previously tested material). All quizzes were imported into WebCT from the test item bank associated with the course textbook (Renaud, 2003). Online quizzes became available two weeks prior to the examination and were unavailable following the examination. Students had two attempts for each quiz with only the highest mark contributing to the final course grade. Four online quizzes (i.e., two true-false and two fill-in-the-blanks) supported learning for the second midterm examination and contributed 5% to the final course grade. Ten online quizzes (i.e., five true-false and five fill-in-the-blanks) supported learning for new content assessed on the final examination and contributed 10% to the final course grade. Students completed the online quizzes without supervision and were advised to refer or not refer to their textbook as they chose. The mean student grade for quizzes associated with the second midterm examination was 91.5% (range 0 to 100%) and mean student grade for quizzes associated with the final examination was 80.5% (range 0 to 100%). Within the context of the educational psychology course, the online quizzes served two functions; contributing 15% to the final course grade and helping students prepare for two in-class examinations.

Figure 1 provides a graphic representation of the pattern of online learning support and in-class examinations. The research design is an ABAB analysis; the A condition is online study groups and the B condition is individual online quizzes. The effect of A and B on in-class examination performance is measured.

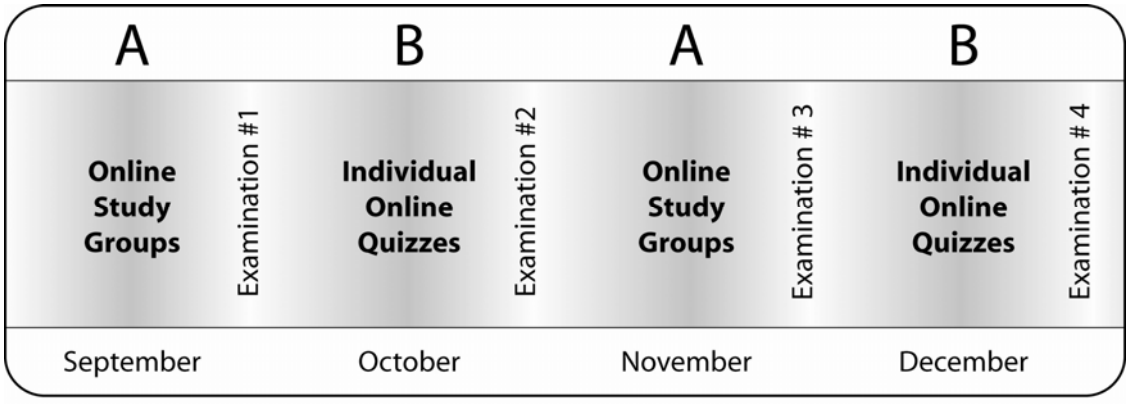

Figure 1. ABAB Research Design: Individual Online Quizzes and Online Study Groups

Measures

To address the research questions, three variables were measured. First, student preference for online study tools was determined with four questionnaire items. Second, student learning style was assessed with 40 questionnaire items. Third, student academic achievement was measured via in-class examinations.

Student Evaluation of Online Study Tools

Four questionnaire items requiring yes-no response assessed student preference for online study tools. Two items reflected preference for the study strategy in traditional format. Yes-no responses allowed for two-group comparisons (i.e., students who agreed compared to students who disagreed with each evaluative questionnaire item). Table 1 presents the percentage of students who responded in the affirmative and negative to the four questionnaire items that assessed personal preference for the two online study tools.

Preference Questionnaire Item	YES	NO
I prefer face-to-face study groups rather than online study groups.	58.3%	41.7%
I prefer pencil-and-paper quizzes rather than online quizzes.	45.8%	54.2%
The online study groups helped me more than the online quizzes.	37.5%	62.5%
The online quizzes helped me more than the online study groups.	60.4%	39.6%

Table 1: Students Responding in the Affirmative and Negative to Preference for Online Learning Support

Student Learning Style

Student learning style was measured with the Index of Learning Styles (ILS) developed by Felder and Silverman (1988). The ILS has been used with college students (Felder & Brent, 2005) and reliability and validity are established (Felder & Spurlin, 2005). The ILS classifies students along four continuums of learning style:

1. *Active* (e.g., learns by doing and enjoys working with others) versus *Reflective* (e.g., learns by thinking and prefers working alone)
2. *Visual* (e.g., prefers to learn with diagrams,) versus *Verbal* (e.g., prefers written and spoken explanations)
3. *Sequential* (e.g., linear thinking, learns in small steps) versus *Global* (e.g., holistic thinking, learns in leaps)
4. *Sensing* (e.g., practical, concrete thinker) versus *Intuitive* (e.g., innovative, abstract thinker)

Each dimension of learning style was measured with 10 questionnaire items; each item had two response-options, the first response-option corresponded to first category of the dimension and the second response-option corresponded to the second category of the dimension. To illustrate, the questionnaire item, *I understand something better after I*, was followed by the two options, *try it out* and *think about it*, of which the student selected one.

Student learning style was determined for each category on each continuum. The number of first response-options selected was summed and indicated orientation toward the first learning style category on the continuum; the number of second response-options selected was summed and indicated orientation toward the second learning style category on the continuum. These two sums were subtracted so that a positive score indicated tendency toward the first category on the continuum and a negative score indicated tendency toward the second category. Table 2 provides descriptive statistics for the four dimensions of learning style for the sample of college students.

Learning Style Dimension	Range[a]	Mean	Standard Deviation
Active – Reflective	- 6 to 10	1.63	4.36
Visual – Verbal	- 9 to 10	2.23	5.43
Sequential – Global	- 8 to 8	1.27	4.08
Sensing – Intuitive	- 10 to 10	0.71	5.39

[a] Positive scores indicate tendency toward the first learning style on the continuum; negative scores indicate tendency toward the second.

Table 2: Descriptive Statistics for Dimensions of Learning Style

Student Academic Achievement

Student achievement was measured with the objective test items on three midterm examinations and one final examination. Each midterm examination contained 24 multiple choice items and the final examination contained 80 multiple choice items (36 items assessed knowledge of previously tested material and 44 items assessed mastery of course material covered subsequent to the third midterm examination). The percentage of multiple choice items answered correctly on the first and third examinations was averaged, resulting in a score for each student for all objective test items completed immediately after the online study group condition. The percentage of multiple choice items answered correctly on the second examination and the final examination (i.e., previously untested material) was averaged, resulting in a score for each student for all multiple choice items completed immediately after the individual online quizzes condition, except review items. T-test analysis revealed no significant difference in average student achievement across the two study conditions.

Results

Students who indicated a preference for face-to-face study groups rather than online study groups (i.e., responded in the affirmative to the questionnaire item) were different than students who did not indicate such a preference. As presented in Table 3, students who tended to be more active than reflective, however, demonstrated a significant preference for face-to-face study groups. While a traditionally accepted level of significance ($p < .05$) was not achieved, likely due to small sample size ($n = 48$), it may be worth noting that students who tended to be visual as opposed to verbal learners, also preferred real rather than virtual study groups.

Learning Style Dimension	Mean[a]	*df*	*t*	*p*
Active – Reflective	Yes = 3.00	46	2.762	.008
	No = -0.30			
Visual – Verbal	Yes = 3.36	46	1.740	.089
	No = 0.65			
Sequential – Global	Yes = 1.39	46	0.243	.809
	No = 1.10			
Sensing – Intuitive	Yes = -0.21	46	-1.419	.163
	No = 2.00			

Table 3: Learning Style Differences for Students who Agree and Disagree with the Questionnaire Item *I Prefer Face-to-Face Study Groups Rather than Online Study Groups*

As presented in Table 4, students who tended to be more active than reflective, however, demonstrated a clear preference for online rather than traditional quiz format. As presented in Tables 5 and 6, active-reflective, sequential-global, and sensing-intuitive learning styles were unrelated to preference for one online study tool over the other. Students who tended to be more visual than verbal, however, demonstrated a significant preference for online quizzes rather than online study groups.

No significant relationships emerged for any learning style between student achievement on objective in-class examination items immediately following the individual quiz condition. However, active learners and visual learners appeared disadvantaged under the online study group condition. Students who were more active than reflective and those who were more visual than verbal tended to score lower on the objective in-class examination items immediately following the online study group condition (Table 7).

Learning Style Dimension	Mean[a]	*df*	*t*	*p*
Active – Reflective	Yes = -0.18	46	-2.832	.007
	No = 3.15			
Visual – Verbal	Yes = 0.95	46	-1.517	.136
	No = 3.31			
Sequential – Global	Yes = 1.36	46	0.143	.887
	No = 1.19			
Sensing – Intuitive	Yes = 0.27	46	-0.511	.612
	No = 1.08			

Table 4: Learning Style Differences for Students who Agree and Disagree with the Questionnaire Item *I Prefer Pencil-and-Paper Quizzes Rather than Online Quizzes*

Learning Style Dimension	Mean[a]	*df*	*t*	*p*
Active – Reflective	Yes = 0.44	46	-1.471	.148
	No = 2.33			
Visual – Verbal	Yes = -0.28	46	2.630	.012
	No = 3.73			
Sequential – Global	Yes = 0.67	46	0.791	.433
	No = 1.63			
Sensing – Intuitive	Yes =1.11	46	0.398	.693
	No = 0.47			

Table 5: Learning Style Differences for Students who Agree and Disagree with the Questionnaire Item *The Online Study Groups Helped Me More than the Online Quizzes*

Learning Style Dimension	Mean[a]	*df*	*t*	*p*
Active – Reflective	Yes = 2.21	46	1.146	.258
	No = 0.74			
Visual – Verbal	Yes = 3.69	46	2.419	.020
	No = 0.00			
Sequential – Global	Yes = 0.79	46	-1.002	.322
	No = 2.00			
Sensing – Intuitive	Yes = 0.21	46	-0.794	.432
	No = 1.47			

Table 6: Learning Style Differences for Students who Agree and Disagree with the Questionnaire Item *The Online Quizzes Helped Me More than the Online Study Groups*

	In-Class Examination Marks under Online Study Condition	
Learning Style Dimension	Individual Quizzes	Study Groups
Active – Reflective		-.40 ($p < .01$)
Visual – Verbal		-.29 ($p < .05$)
Sequential – Global		
Sensing – Intuitive		

Table 7: Correlations between Dimensions of Learning Style and Achievement under Online Study Conditions

Discussion and Implications for Practice

Felder and Silverman (1988) suggested that active learners retain and understand information by discussion and application. Active learners like group work while reflective learners prefer to work alone. Felder and Silverman recommended that active learners study in groups in which members take turns explaining different topics to each other. The online study groups in the current investigation were asynchronous (i.e., interaction occurred in delayed time) and in this regard may not provide for the real-time spontaneous interaction preferred by active learners. The active learners in the current investigation expressed preference for face-to-face study groups rather than online study groups suggesting that they were aware of the study format most conducive to their learning. The instructional effectiveness of asynchronous communication tools has been attributed to increased time for student reflection (Johnson, Howell, & Code, 2005; Koory, 2003); synchronous communications tool (e.g. chat) are typically perceived as social rather than educational (Burnett, 2003). However, synchronous communication is more active than reflective and may provide active learners with a better online study group format than asynchronous communication tools. Both synchronous and asynchronous online study groups may provide for the instructional needs of both active and reflective learners.

Active learners also expressed preference for online quizzes rather than pencil-and-paper quizzes. Indeed, the WebCT quiz tool requires more active learner involvement (e.g., item selection) than conventional hard quizzes (Kerlin, 2005). Felder and Silverman (1988) acknowledged that active learners are disadvantaged and uncomfortable in traditional lectures where the only activity is writing notes. Hybrid learning environments may provide for the needs of students with various learning styles.

Visual learners expressed the perception that the online quizzes were more helpful than the online study groups. According to Felder and Silverman (1988), visual learners are inefficient processors of auditory information. Such learners retain and comprehend pictures, diagrams, flow charts, time lines, video, and demonstrations. In most college classes, little visual information is provided; students primarily listen to lectures and read written presentation on PowerPoint, whiteboard, and handouts. While both the online study conditions in the current investigation required reading and writing, the language demands were greatest in the study group condition. Additionally, the WebCT quiz tool makes use of icons and the interface is more visually complex than that associated with the WebCT discussion tool (Kerlin, 2005). Such increased visual stimuli may be compatible with the cognitive characteristics of visual learners.

There are two interpretations of the significant inverse correlations between learning style and academic achievement under the online study group condition. It may be that reflective and verbal learners were advantaged by the study groups, while active and visual learners were not. Alternatively, it may be that the academic disadvantage of active and visual learners was neutralized by the online quizzes. Both interpretations suggest the value of a range of study tools to accommodate variation in student learning style.

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