

The Impact of Student Verbal/Visual Learning Style Preference on Implementing Groupware in the Classroom

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ABSTRACT

Educators believe that group projects are an increasingly essential part of classroom assignments. The working world is one of working groups, and student exposure to the benefits and pitfalls of group work is assumed to be beneficial for all students. However, in distance education and other asynchronous learning environments, group work may be difficult to incorporate in the classroom. Among other problems, face-to-face student meetings may be difficult or impossible to facilitate in some classes. Recent innovations in groupware have made it possible for educators to address these problems and to enhance the group experience through exposure to technologies that increase effectiveness and/or efficiency of group work. This study reports the impacts of adding groupware technology to project groups in accounting classes. Students who preferred a more visual learning style reported that the use of groupware enhanced their group project experience and helped the project run more smoothly. Students who preferred learning more verbally found significantly less enhancement from the use of groupware and did not feel that the groupware helped the project process as much.

KEYWORDS

Groupware, Verbal/Visual learning style

I. INTRODUCTION

Traditional classes and classes taught via distance education (DE) both make use of group projects as a means of teaching students the important lessons of group work. Group work helps students learn to cooperate, count on member input and achievement, and live with group outcomes. The idea is to give students a model of this important aspect of the working world. However, no matter how groups are structured, problems with group communication tend to persist, especially in asynchronous (e.g., Internet-based) and DE settings. Not all group members contribute their share of work because of miscommunication, because face-to-face meetings may be nearly impossible to schedule, or because some members may dominate the discussions to the detriment of the group process.

Therefore, the availability of groupware to improve group communications in the classroom is welcomed by many educators. For example, Lotus Notes/LearningSpace groupware is currently being utilized in over thirty higher education settings throughout the country. In addition, this relatively new technology is increasingly being implemented at companies. As a result, groupware implementation in classrooms also provides students the opportunity to experience real world, cutting edge technology.

Student groups may experience certain benefits when they use groupware. For example, the software may facilitate communication, thereby increasing group efficiency. Group members may share problems and perils they encounter during a project at any time, not just when the group gets together for a face-to-face meeting. Communication with the entire group, rather than one group member at a time (as with email) may allow for increased efficiency in finding solutions. In addition, keeping group members aware of the project's progress in real time may lessen the consequences of problems.

Groupware may also increase group effectiveness. The use of group knowledge and resources for maximum benefit may be more likely when the group has this additional means of communication. Group members may be more likely to succeed at group tasks if difficulties are easily shared and requests for help are considered by all group members. In addition, the nature of group communication using groupware might lead to increased effectiveness. For example, group members who might not be willing to ask a question in a meeting might be more willing to ask via groupware; group members who might not be willing to show their knowledge in a meeting might be more willing to help out via groupware.

Groupware also has the potential to ease scheduling problems and improve group coordination. More group meetings may be held because the physical location of individuals need not be coordinated. In addition, when groupware is accessed via the internet, group members may have increased access to group communications outside of the school setting.

All of these potential benefits make the concept of groupware for students very appealing for educators and students. However, while exposure to new technologies such as groupware is expected to be helpful to students, the extent to which it decreases group problems in a classroom setting depends on whether or not students embrace the technology. This study investigates the hypothesis that a student's preference for learning verbally or visually may affect whether the use of groupware benefits students. The results show that students whose preferred learning style is more visual showed reported higher levels of effective groupware use, and reported greater benefits for the group process from using groupware, than did those whose preferred learning style is more verbal. Opportunities for future research in this area are discussed.

II. PRIOR LITERATURE AND HYPOTHESES

Wilson, Morrison and Napier [1] investigated which aspects of computer-mediated communications are most effective for student groups. They found that computer-mediated communications (email, in their experiment) were most effective for tasks that generate information, including those involving creativity and planning. Wilson et al. [1] also found that computer-mediated communication was not very effective for tasks involving choice such as decision making tasks.

Not only are some tasks better suited to computer-mediated communication, but some students will benefit from using technology more than others. Individual differences in students' responses to learning settings/materials have been proposed in prior research. Snow [2] proposed that an Aptitude-Treatment Interaction (ATI) is a complex set of interactions between learners and treatment characteristics. No one personality variable may be most important in this interaction, but a wide variety of personality variables may affect learning. Similarly, Kozma [3] proposed that technology may impact learners more in some situations than it does in others because of the interaction between the task, the learners, and the technology.

Student learning style is one of the aspects of student personality that appears to play a role in

determining how much a student learns. Some fields, including engineering, are already implementing this idea in the classroom. For example, Felder [4] cites the use of learning style measures as one means of improving the match between instructors' methods and student learning. There are many dimensions of a student's learning style that may be important; this study examines the preference for learning verbally versus learning visually. Computer technology such as groupware relies heavily on visual stimuli and therefore it may appeal more to students who prefer to learn more visually than it does to those who prefer to learn more verbally.

Although there is no reason to think that students who have a preference for learning verbally will not be able to learn using technology, prior research has shown that student preferences may affect student learning, and a student may learn more if (s)he studies by a method that is consistent with these preferences [5]. If learning materials conflict with a student's preferred method of processing information, the materials may not be helpful to the student [6]. If the materials are consistent with the student's preference, use of the materials may benefit students [7].

The concept of verbal versus visual learning preferences comes from Paivio's Dual Coding Theory [8], which addresses a person's preferred method of processing information. This theory proposes that information is either coded in a network composed of language based information (the verbal sub system) or it is coded in a network composed of nonverbal information (the imagery sub system). This theory suggests that although everyone codes information in both subsystems to some extent, individuals differ in their preferred representational style. Some people prefer verbal representations and others prefer visual representations. Prior experiences and innate ability may both play a role in determining a person's preference [9]. Prior research has used the Individual Differences Questionnaire first validated by Harshman and Paivio [9] to measure students' learning style. For example, Butler and Mautz [7] found that students who preferred a visual learning setting benefited most from multimedia presentations.

We hypothesize that student learning style may affect student use of groupware. To the extent that a student prefers to learn with more visual information, groupware may seem beneficial and helpful to the student performing group work. To the extent that a student prefers to learn with more verbal information, groupware may not appear to be beneficial or helpful. Our first hypothesis regarding learning style impacts on groupware implementation in the classroom is:

H1: Students whose preferred learning style is more visual will perceive that groupware is more effectively used by the group than will students whose preferred learning style is more verbal.

That is, we propose that students who prefer to learn more visually than verbally will feel that their groups made effective use of the groupware in achieving the major goals of the project. Some of the possible reasons that these students would have this perception are: 1) these students encourage their entire group to use the software to facilitate the group process, 2) they are more interested in trying out the software and determining its effects, and 3) they attribute their group's successes to use of the software, among others. These explanations of the effect are not a focus of this paper, but are discussed in section V of this paper. We also propose that students who prefer to learn more verbally will report less effective use of the groupware. Whether this effect is due to less use of the software, less interest in its effects on the project, less willingness to attribute group success to use of the software or other reasons is not a focus of this paper.

Hypothesis 1 addresses perceptions about effectiveness of groupware use by students. Whether or not a student perceives that his/her group effectively used the groupware to achieve project goals, the student

may perceive that there were benefits from using groupware. We believe that whether the level of perceived effectiveness is relatively high or relatively low, groupware could have positive effects on the group process. We hypothesize that these positive effects will be stronger for students with a preference for visual learning. Our second hypothesis regarding learning style impacts on groupware implementation in the classroom is:

H2: Students whose preferred learning style is more visual will perceive groupware to be more beneficial for the group process than will students whose preferred learning style is more verbal.

This hypothesis is consistent with the premise that a student may learn more if (s)he studies by a method that is consistent with their [5]. We propose that a student will perceive more benefit from groupware if they are a more visual learner. Of course, perceived benefit differs substantially from actual benefit, which is what is hypothesized in prior research [6],[7]. This higher level of perceived benefit may arise from factors similar to those discussed above; this study does not address differences in actual benefit from the use of groupware.

III. METHODOLOGY

A. Procedure

Thirty eight students (21 males and 17 females) in two sections of an upper division accounting course participated in the study as part of the class. In 3-person groups, students investigated internal controls over cash and revenue for actual local companies. Students chose their own groups, and group membership did not change during the course of this study. Students chose the companies they investigated, conducted interviews, and created reports for their companies as though they were consulting auditors. Students generally found the projects motivating, interesting and time consuming.

The group project was eight weeks in length, and accounted for 25% of the course points. Students within groups were all in the same section, which facilitated face-to-face communications. Use of groupware (LearningSpace from Lotus Development Corporation) was mandated for parts of the project and additional use of the software was optional throughout the project period. The suite of databases incorporated into LearningSpace allows students to create individual profiles, access digitized documents, conduct threaded conversations, participate in surveys and assessments and access an online schedule of activities via the Internet.

All students used the groupware for a minimum of 10 required uses. Assignments included finding requirements (in document form) for the project, participating in group discussions, answering instructor queries and keeping logs of usage difficulties, among others. LearningSpace allows the instructor to track all uses of the system by each student, which facilitated the data collection. Individual student use varied from 10 times (the minimum) to more than 40 times. Total number of uses per student is a very rough measure of student interest level in the software, and is not expected to correlate with visual/verbal classification. For example, one student used the software approximately 10 times before he found the diary he was asked to complete, and another student sent six responses to a survey because she did not get immediate confirmation from the system that her response had been received. Most students reported that the software was easy to learn to use and that they did not experience any unusual difficulties understanding the assignments.

At the start of the project, a professional trainer gave students 30 minutes of demonstration on use of the groupware, as well as comprehensive handouts describing its features. Students were generally

satisfied with the level of training, reporting no substantial difficulties in learning to use the groupware. Student learning styles and groupware effectiveness were measured in surveys conducted in class for extra credit points. Students were unaware of the purposes of the surveys.

B. Measurement Instruments

The Individual Differences Questionnaire [9] was used to measure whether a student's learning style preference was more verbal or visual. Students rated agreement on a 5-point Likert scale with a set of questions that addresses various aspects of learning. As is consistent with prior [7], principal components factor analysis showed that six items produced the final measure; these items are shown in Table 1.

Groupware effectiveness was measured using items adapted from Wilson, Morrison and Napier [1]. The questions asked are shown in Panel A of Table 2. Students rated each item on scale of 1 (strongly disagree) to 5 (strongly agree). The closer the average rating is to 5 the more effective groupware is rated. Orthogonal principal components factor analysis showed that the five questions load into one factor.

The contribution of the groupware to the group process itself was also examined. Responses to the questions shown in Panel A of Table 3 were made on the same scale as is described above. Orthogonal principal components factor analysis showed that the two questions load into one factor.

IV. RESULTS

The student learning style measure was created by summing the answers to the six questions used (see Figure 1). Students whose total score was above the mean were placed in the Verbal Learners group, and those with a total score below the mean were placed in the Visual Learners group. Nineteen students are in the Visual group and 19 students are in the Verbal group. To further support this categorization of students, students' ACT reading scores were obtained, and correlation with the visual/verbal classification was run. The correlation between these variables is significant at .5726 ($p < .005$). A higher ACT reading score is positively correlated with the visual/verbal learning style classification, supporting the categorization scheme.

Using this classification scheme, there was 1 group with all members rated as "Visual," there were 2 groups with all members rated as "Verbal" and 10 groups with at least one student in each category. Because only 3 of 13 groups were of all one type of student, and since there were both all-visual and all-verbal groups in the 3, it is unlikely that the results of the analysis shown below were significantly affected by a group think factor (where students in a group decided that the software was especially good or bad).

Items included in learning style measure:

1. I find it difficult to find enough synonyms or alternate forms of a word when writing.
2. I have difficulty expressing myself in writing.
3. I am able to express my thoughts clearly.
4. I am fluent in writing essays and reports.
5. I often have difficulty in explaining things to others.
6. I often have ideas that I have trouble expressing in words.

Questions 1,2, 5 and 6 are worded so that a low number indicates stronger verbal preference, while questions 3 and 4 are worded so that a low number indicates stronger nonverbal preference. Data was coded so that a higher overall score indicates a student prefers to learn visually, and a lower score indicates a student prefers to learn verbally.

Table 1. Assessment of Student Learning Style Preference

Students' total scores on the group effectiveness factor (Table 2) were used to assess the results of hypothesis 1. ANOVA results are reported in Panel B of Table 1. There is a significant difference ($p=.03$) in reported effectiveness of the groupware between students in the verbal and visual groups. Students in the verbal group reported an average effectiveness score of 15.16 (out of possible 25) while those in the visual group reported an average effectiveness of 17.68. The means are in the anticipated direction and hypothesis 1 is supported. Students who prefer a more visual learning style perceived the groupware to be more effectively utilized in achieving the project goals.

Panel A: Factor Composition: Group Effectiveness					
This factor includes responses to these statements:					
<ol style="list-style-type: none"> 1. My group made effective use of the software to discuss control environment questions. 2. My group made effective use of the software to discuss control procedure questions. 3. My group made effective use of the software to discuss our interview analysis. 4. My group made effective use of the software to discuss how to solve project problems. 5. My group would have made better use of the software if more use of the software had been mandatory. 					
Panel B: ANOVA Results					
<u>Source</u>	<u>Sum of Squares</u>	<u>df</u>	<u>Mean Square</u>	<u>F Value</u>	<u>Prob</u>
Visual	60.6316	1	60.6316	4.91	.0331
Error	444.6316	36	12.3509		
Total	505.2632	37	72.9825		

Table 2. Analysis of Groupware Effects on Group Activities

Students' total scores on the group process factor (Panel A, Table 2) were used to assess the results of hypothesis 2. ANOVA results are reported in Panel B of Table 2. There is a significant difference ($p=.0001$) in reported contribution of groupware to the group process between students in the verbal and visual groups. Students in the verbal group reported an average score of 5.16 (out of possible 10) while those in the visual group reported an average score of 7.26. The means are in the anticipated direction; hypothesis 2 is supported. The more visual students perceived that the groupware improved the group process more.

Panel A: Factor Composition: Group Process					
This factor includes responses to these statements:					
1. The group process of meeting and communicating was made easier by the use of groupware.					
2. Compared with other group projects, this one went more smoothly because the groupware provided another means of communicating with group members.					
Panel B: ANOVA Results					
<u>Source</u>	<u>Sum of Squares</u>	<u>df</u>	<u>Mean Square</u>	<u>F Value</u>	<u>Prob</u>
Visual	42.1053	1	42.1053	19.89	.0001
Error	<u>76.2105</u>	<u>36</u>	<u>2.1170</u>		
Total	118.3158	37	44.2223		

Table 3. Analysis of Groupware Effects on Group Process

There were no differences between the two groups for difficulty in learning to use the software ($p=.65$) or training effectiveness ($p=.71$). There were also no differences in students' reported levels of prior familiarity with the use of groupware in general or this groupware specifically (only one student reported prior familiarity) or ability to use other technologies ($p=.49$). In addition, there were no gender effects for either the effectiveness ($p=.33$) or process measures ($p=.34$).

V. DISCUSSION

The results obtained in this experiment indicate that students who can be categorized as more visual learners perceive added benefit from utilizing groupware in a group project. In this study, students whose preferred learning style is more visual perceived that their groups made more effective use of groupware in achieving project goals. In addition, students identified as more visual learners considered the inclusion of groupware to be valuable to the group process itself. It is important to note that while the more visual learners reported greater benefit to the use of groupware than the more verbal learners, all students were able to master the required course material and complete the project successfully. This study addresses differences in perceptions and not differences in actual benefits.

The two measures of perceived benefit from using groupware, effective use of the groupware and helpfulness of the groupware for the group process, are closely related constructs. However, the

correlation coefficient for these two measures in this study is .3573 ($p=.150$). This shows that these two measures are not identical. We propose that these are only two of the perceived benefits student groups may realize when using groupware. Potential other benefits include improved project outcomes due to superior communication opportunities, and superior outcomes due to the different nature of communications, among others. In addition, future research may be able to determine the exact nature of differences in outcomes that arise from using groupware versus more traditional communication methods.

Instructors are beginning to incorporate groupware in various educational settings. As instruction typically accomplished through traditional delivery continues to shift to asynchronous methods of delivery, it is likely that groupware tools will occupy a more prominent role in education. We already see MBA programs around the country that have some classes (if not all) on the internet and other classes on DE networks. Classes in these formats are spreading through undergraduate curricula as well. Groupware makes group projects in such classes feasible. Students who never physically meet can conduct group projects. In addition, instructors' quests to incorporate the latest information in courses already overflowing with traditional content may lead to increased groupware use as a means of keeping group communication capabilities high while reducing class time spent on such communications.

As the use of groupware increases, the extent to which it serves a broad and diverse student population may become more important. For example, a student's individual characteristics such as preferred learning style may lead a student to choose a DE course offered from one institution over another because of perceived benefits or difficulties associated with course instructional methods. Naturally, there are many additional reasons that a course is selected, but this small factor could be the deciding one for some students.

Although this study did not detect differences in the two groups due to difficulty in using the software or gender differences, further study in the area is needed due to the small sample size used here. As the demographics of students change to include more returning adult students, it may become more desirable to assess preferred learning styles prior to the start of a course. These methods are already being implemented in some settings, including in engineering courses at some schools [4]. Returning students may be less visually oriented than traditional students, or they may be less willing to incorporate technology in their projects. Because courses that are completely asynchronous (no face-to-face meetings) are a growing portion of the array of educational opportunities available to these students, educators need to be vigilant about the impacts of course materials on student success. These students may be less attached to the location from which a course is offered and more concerned about other factors such as the extent to which the course suits their individual preferences. While it certainly is not feasible to tailor course materials to each student, consideration of students' individual needs may allow institutions to compete for students who otherwise would have little chance of attracting students to their programs.

Other than its small sample size, one of the main limitations of this study is its ability to determine which of several competing hypotheses may most accurately explain the results. Future research may attempt to explain these findings further by investigating some of these competing hypotheses. Interesting insights might arise from determining if the more visual students encouraged the use of groupware for communication while the more verbal students discouraged its use. More complete usage data would permit analysis beyond the simple number of times each student used the software. It would also be interesting to investigate whether these results are due to a difference in attribution of the effects of groupware. That is, do more visual learners attribute group success to groupware, while more verbal learners attribute group success to other factors? These are only a few of the interesting questions that

remain concerning the impact of student learning style on technology implementation in the classroom.

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