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A Formative Analysis of the Use of Online Discussion Boards

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### Abstract

The purpose of the current study was to explore the use of discussion boards by secondary school students in an introductory computer class. Forty-five male students, ranging in age from 13 to 15 years old, participated in two consecutive online discussions used to supplement the learning of HTML (24 days) and beginning programming (36 days) respectively. Two hundred and sixty messages were analyzed, as well as post-tasks surveys and statistics on actual use automatically collected by the discussion board software. Twelve were examined including: social learning, cognitive processing, quality of discussion, the initial question, role of educator, navigation, challenges for students, types of users, attitudes toward discussion, response time, learning outside of school, and performance. The discussion board to actively understand and apply new concepts and procedures related to learning HTML and programming. The majority of students posted clear, good quality messages that covered material that went beyond the standard curriculum. Discussion occurred outside of school hours on a regular basis. The quality of questions starting off a discussion did not have a significant impact on participation. The role of the educator was minimal and unrelated to participation or quality of the discussion board. The number one challenge students experienced were problems due to navigating the large number of messages. Students could be differentiated on their level of participation and attitudes toward using the discussion with one third being enthusiastic, frequent participants, one third occasional and indifferent, and one third participating infrequently, if at all. Long delays in responding to messages had a significant, negative impact on how often subsequent messages were read. Finally, and perhaps most important, participation in the discussion board had a significant, positive effect on learning performance.

## A Formative Analysis of the Use of Online Discussion Boards

### *Overview*

The use of online discussion boards has grown extensively in the past 5 years (Cooper, 2001). While this tool is viewed as revolutionary by some researchers (Hara, Bonk & Angeli, 1998; C., Li, 2003), others argue our understanding of how to use online discussion in an effective and meaningful way is minimal at best (Blignaut & Trollip, 2003).

Considerable research has been done on use of online discussion in higher education (e.g., Berge & Muilenburg, 2000; Blignaut & Trollip, 2003; Burstall, 2000; Hara et. al., 1998; Mazzolini, M. & Maddison; 2003; Wickstrom, 2003), but not at secondary level (Knowlton & Knowlton, 2001; Love, 2002; Scrum & Hong, 2002). Furthermore, most studies have looked at one or two specific aspects of online discussion in detail. Several researchers have attempted more complete analyses (e.g., Hara et. al., 1998; Zhu, 1998), although the scope is still somewhat limited with respect to the full range of factors that could influence successful performance.

The purpose of this study is to provide a comprehensive analysis of the use of online discussion at the secondary level. Twelve areas will be examined including: social learning, cognitive processing, quality of discussion, the initial question, role of educator, navigation, challenges for students, types of users, attitudes toward discussion, response time, learning outside of school, and performance.

### *Social Learning*

Vygotsky (1978) was a pioneer in exploring the role of language in thought. He noted that conceptual learning was a collaborative effort requiring supportive dialogue. Slavin (1995) adds that extensive research supports the positive effects of cooperative learning on

achievement. It is reasonable, then, to expect that online discussion has the potential to support collaboration and concept development. A number of researchers, though, have reported that true social interaction leading to cognitive development is rare (e.g., Berge & Muilenburg, 2000; Hara et. al., 1998; Son, 2002; Wickstrom, 2003). In fact, Hara et. al. (1998) reported that most students rarely participated a second time in an online discussion thread.

### *Cognitive Processing*

While detailed content analyses of discussion boards have been done by several investigators (Berge & Muilenburg, 2000; Hara et. al, 1998; Zhu; 1998), only Berge & Muilenburg (2000) and Knowlton & Knowlton (2001) used a theoretically based taxonomy to investigate cognitive processes. To date, there is little systematic research to guide the use of discussion boards in promoting higher level thinking, although Savage (1998) provides a list of reasonable, yet untested suggestions. The current study will use a revised version of Bloom taxonomy (Anderson, & Krathwohl, 2001) to look at both knowledge and processing level of discussion board messages.

It should be noted that because the sample in this study is collected from secondary students who 13 to 15 years old, the level of knowledge and processing may be concentrated at the concrete operational stage (Piaget, 1954; 1974). In other words, some students may not have the ability to think at a metacognitive or abstract level.

### *Quality of Discussion*

Discussion quality has been looked at from several angles – awareness of tone (Knowlton & Knowlton, 2001), reasoning (Love, 2002), level of controversy (Burstall, 2000), and content (Blignaut & Trollip, 2003; Merryfield, 2001). The results suggest that students need to be aware

of their tone to avoid misunderstanding (Knowlton & Knowlton, 2001), messages are not always easily understood (Love, 2000), and interaction is improved with more controversial issues that do not have a specific, concrete answers (Blignaut & Trollip, 2003; Burstall, 2000).

### *Initial Question*

Previous research suggests that the initial question starting off a discussion board thread is germane to the quality of subsequent interaction (Berge & Muilenburg, 2000; Hara et. al., 1998; Savage, 1998; Wickstrom, 2003) Specifically, more successful questions are clear (Berge & Muilenburg, 2000), provocative (Love, 2002) and promote higher level thinking (Savage, 1998). However, Hara et. al. (1998) noted that was challenging to discover clear patterns in questioning. Part of the problem stems from not having a clear metric. The current study addresses the measurement issue by using specific scales designed to evaluate message quality, type of knowledge and processing level, and clarity of subject line.

### *Role of Educator*

The role of the educator in an online discussion has received considerable attention (Berge & Muilenburg, 2000; Blignaut & Trollip, 2003; Burstall, 2000; Figallo, 1998; Hara et. al. 1998; Knowlton & Knowlton, 2001; Li, 2003; Love, 2002; Mazzolini & Maddison, 2003; Moller, 1998; Wickstrom, 2003), although researchers have yet to agree on the most appropriate strategy. One school of thought proposes that educators are critical to the success of an online discussion (Blignaut & Trollip, 2003; Figallo, 1998; Knowlton & Knowlton, 2001; Love, 2002; Moller, 1998). The educator is there to raise the level of discussion to a higher level (Figallo, 1998). Moreover, giving students the responsibility to determine the direction is not a viable approach (Moller, 1998). The other school of thought claims that educators should take a back

seat and let students construct their own knowledge (Burstall, 2000; Li, 2003; Mazzolini & Maddison, 2003). These researchers have reported that peer messages are more effective than educator messages at stimulating a discussion and that instructor presence can actually shut a discussion down (Li, 2003; Mazzolini & Maddison, 2003).

### *Navigation*

Students and instructors can face considerable problems trying to navigate through a typical discussion board. Specific problems observed include length of message (Hara et. al., 1998), number of entries (Burstall, 2000; Hara et. al., 1998; Hammond, 2000; Knowlton & Knowlton, 2001; Son, 2002; Wickstrom, 2003), unclear subject lines (Hara et. al., 1998) and lack of organization (Chen & Hung, 2002; Li, 2003). In other words, the number and length of messages can be overwhelming, particularly if message are not organized well. Chen and Hung (2002) suggest that the traditional threaded discussion format may be inadequate for true knowledge building.

### *Challenges for Students*

The challenges students face in participating in online discussion are many - perceived inability to participate (Wickstrom, 2003), reticence of many users, especially beginners, to add messages (Hammond, 2000; Mazzolini and Maddison, 2003), writing being naturally more slower than talking (Hammond, 2000), inability to change thoughts once they are written down and public (Hammond, 2000), extensive amount of time taken to participate (Son, 2002), lack of personal interaction (Weiss, 2000), lack of organization and self-discipline (Schrum, 2002) , misinterpretation of humor or sarcasm (Berge & Muilenburg, 2000), and the negative effective

of being graded (Wickstrom, 2003). Most of these studies were done in higher education, so it is unclear whether secondary students will experience the same concerns.

### *Types of Users*

There is some evidence to suggest that students assume specific and distinct roles as a discussion board evolve (Hammond, 2000; McGrath & Hollingshead, 1994; Palloff & Pratt, 1999) Wickstrom, 2003). These roles are based on level of participation (Hammond, 2000; Wickstrom, 2003), degree of reflection (Hara et. al., 1998), and mediation skills (Palloff & Pratt, 1999). Some students who have limited writing or verbal skills may be at a distinct disadvantage (Hara et. al. , 1998). To date, there has been no systematic attempt to investigate individual differences in online discussion participants.

### *Attitudes Toward Discussion*

Surprisingly little systematic research has been done examining student attitudes toward online discussion. Hammond (2002) and Son (2002) reported that students were generally positive about using online discussion, but this conclusion was supported by anecdotal evidence. Several researchers have observed that students tend to do the bare minimum when participation is mandatory (e.g., Hara et. al, 1998; Wickstrom, 2003). Clearly more research is needed in this area.

### *Response Time*

Online dialogue differs from face-to-face conversation in several ways, but one key difference is that there are inevitable delays between the posting of messages within a thread. This means that students who post questions or responses may need to repeatedly check the

discussion board in order to continue the conversation. Son (2002) speculated that these delays in learning could be a problem, although data has yet to be collected in this area.

### *Learning Outside of School*

A large number of discussion boards are used in conjunction with face-to-face learning (e.g., Hara et. al., 1998; Love, 2002; Scrum & Hong, 2002), yet there is no research on how much discussion actually goes on outside of school environment. While the assumption may be that students are spending time reflecting and posting messages at home, there is no data to support this supposition.

### *Learning Performance*

Several researchers (Chen & Hung, 2002; Fabos & Young, 1999) have challenged the assumption that mere participation in an online discussion board guarantees the social construction of knowledge and personal understanding. Yet the effect of online discussion on learning performance has yet to be tested (Hara et. al., 1998). Love (2002) suggests that few tools are available for teachers to evaluate how online tools have met their intended goals. It is important that the link between participation and learning be investigated.

### *Current Study*

The purpose of this study is to systemically explore discussion boards used by secondary students to learn HTML and beginning programming in an introductory computer course. Twelve areas representing key concepts addressed in a wide range of studies examining online discussion boards were analyzed including: social learning, cognitive processing, quality of discussion, the initial question, role of educator, navigation, challenges for students, types of users, attitudes toward discussion, response time, learning outside of school, and performance.

## Method

### *Sample*

The sample consisted of 45 secondary school students enrolled in an introductory computer science course at a private school in the greater metropolitan Toronto area. The students, all males, ranging in age from 13 to 15 years old were randomly divided into 2 classes consisting of 22 and 23 students.

### *Procedure*

Students were asked to contribute to two consecutive online discussions used to supplement the learning of HTML (24 days) and beginning programming (36 days). Participation in the online discussion was worth 10% of their final grade. Specific grading guidelines were not provided, so students were free to post as few or as many messages as they wanted. It was emphasized that posted messages consisting of questions or answers would be given equal weighting.

### *Data Collection and Analysis*

Three sources of data were collected and analyzed: (a) the online discussion board messages, (b) statistics accumulated by the discussion board software (Blackboard 5.0) on actual use, and (c) attitude surveys distributed at the end of each topic.

The analysis of discussion board messages and selection of variables was based on an extensive review of the literature (Anderson & Krathwohl, 2001; Blignaut & Trollip, 2003; Hara et. al., 1998; Henri, 1992; Hammond, 2000; Hara et. al., 1998; Love, 2002; Mazzolini & Maddison, 2003; Son, 2002; Zhu, 1998). The specific variables assessed and supporting references that guided the selection of the metric are provide in Table 1.

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Insert Table 1 about here

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After each of the course topics were completed (HTML first, Programming last), students were asked to fill in a survey with the following open-ended questions:

1. Did you use the discussion board? Please explain in detail why or why not.
2. Was the discussion board useful to you? Explain in detail why or why not.
3. Go to the discussion board right now. Play with it for 15 minutes and identify anything you might find useful.
4. After your 15 minutes using the discussion board, what suggestions do you have to make messages more useful?

## Results

### *Overview*

Overall, a total of 260 messages were posted for both HTML and programming. The mean length of a discussion thread was of 3.5 messages ( $SD = 2.3$ ; range 1 to 11 messages) and the average number of words was 48.3 ( $SD = 46.2$ ; range 1 to 263 words). Subject lines were moderately clear ( $M = 1.68$ ,  $SD = .9$ ; scale range from 0 to 3) and the quality of messages was fair to good ( $M = 2.3$ ,  $SD = .9$ ; scale range from 0 to 4). A typical message was read an average of 29.5 times ( $SD = 11.3$ ; range 2 to 77). The average time to respond to a posted message was 3630 minutes or 2.5 days ( $SD = 7377$  minutes; range 1 to 49109 minutes).

With respect to content, a majority of messages were either course related or went beyond the material covered in class ( $n = 223$ , 86%). The primary purpose of most messages

was to ask a question (n = 63, 24%) or to offer an answer (n = 175, 73%). The discussion board was rarely used for non-academic purposes (n= 15, 6%).

### *Social Learning*

Evidence for social learning was based on length of discussion threads, number of messages read, primary focus of posted message, and number of situations where students participated two or more times in the same discussion thread.

The number of discussion threads containing 5 or more messages was 26/55 or 47%. The mean number of times a typical message was read was 29.5 ( $SD = 11.3$ ) and ranged from 2 to 77 times. Specific responses to other students in the form of questions or answers occurred in 66% of all message posted (n= 172). Finally, students participated in the same discussion thread two or more times in 13 out of 28 HTML discussion threads (46%) and 10 out of 35 programming discussion threads (29%).

### *Cognitive Processing*

According the Bloom's revised taxonomy, the predominant knowledge type demonstrated was procedural (n= 140, 57%), followed by conceptual (n= 51, 21%) and factual (n= 50, 21%). Metacognitive knowledge was present in only 3 out of 244 messages evaluated. With respect to processing level, students displayed understanding most (n=85, 35%), followed by remembering (n=66, 27%), applying (n=52, 22%), analyzing (n= 31, 13%) and evaluating (n=10, 4%). Creative use of knowledge was observed only once.

### *Quality of Discussion*

Quality of the discussion was assessed using five variables: message clarity, message quality, the presence of new knowledge, course knowledge, and external resources used.

A majority of messages were clear (n=174, 67%) or somewhat clear (n=70; 27%). Only 16 messages (6%) were unclear. Message quality was good or excellent 41% of the time, fair 47% of the time, and poor or incorrect 12% of the time. New knowledge was added either indirectly (n=69, 27%) or directly (n=103, 40%) in a majority of messages posted.

The content of messages focused mostly on material beyond (n=145, 56%) or directly related to the curriculum (n=78, 30%). Non-academic (n=24, 9%) and administrative issues (n=6, 2%) were discussed infrequently.

### *Initial Question*

The impact of the initial question was assessed by looking at the number of times a message was read and the length of the discussion with respect to 5 variables: whether the question was easily answered elsewhere, subject line clarity, message quality, knowledge type and processing level. Ten one-way ANOVAs revealed no significant differences. In other words, there appeared to be no distinct quality in an initial question that caused students to read or post more questions.

### *Role of Educator*

The philosophy of the teacher in this course was to allow students the opportunity to construct their own knowledge. Therefore, it is not surprising that students initiated questions in 95% (n=50) of the discussion threads started. Students also ended discussions a majority of the time (n=49, 89%).

Overall, there were no significant differences between teacher and student messages with respect to the number of times each were read, length of message, and how fast a message received a response (response time).

### *Navigation*

Navigation issues were examined by looking at the effect subject line clarity and location of message within a thread (message number) on how many messages were read (reading rate) and how fast a message received a response (response time). The clarity of a subject line was not significantly related to reading rate or response time. However, message number was significantly and negatively correlated with average number of times the message was read ( $r = -.26$ ;  $p < .001$ ). There is a steady drop in the average number of times a message is read from the initial message ( $M = 39.18$ ) to message number 11 ( $M = 14.5$ ). Message number was not significantly related to response time..

From the post task survey data, navigation was reported as the number one problem in using the discussion board in both the HTML and programming topics ( $n = 35$ ; 54%). Specific concerns voiced were that it was hard to find specific content because there were too many messages and too much clicking required to access messages. Several students thought that the discussion board was being diluted with messages because students were being graded. A number of students suggested that there should be greater division and classification of topics to decrease navigation time.

### *Challenges for Students*

Aside from navigation difficulties, some students had technical or software problems ( $n = 16/65$ ; 25%), difficulty trusting the quality of their peers messages ( $n = 14/65$ ; 22%), and felt inhibited by the use of grades to motivate participation ( $n = 7/65$ ; 11%).

Students reported a variety of reasons for not using the discussion board including using other methods (using a book, searching the Internet, asking a friend) that were perceived as

being faster or more efficient (n=25/65; 38%), differences in learning style (n=8/65; 12%), lack of ability (n=8/65; 12%), forgetting to post (n=5/65; 8%), and not having enough time (n=4/65; 6%),

### *Types of Users*

Individual differences observed among students who posted 5 or more messages were observed in the average number of message read ( $p < .001$ ), average response time ( $p < .001$ ), number of words used ( $p < .001$ ), and message quality ( $p < .001$ ). Students also differed with respect to the number of message they posted ranging from 1 to 17. Students did not differ significantly with respect to clarity of subject line, difficulty of question answered, knowledge type, and processing level.

In the post task survey, several students (n = 8/65; 12%) reported that they did not participate regularly in the discussion board because it did not match their individual learning style. Some students preferred to use a book – others favored looking up answers on the Internet or simply asking another student. One student learning HTML summed this position with the following comment:

“I did not use [the] discussion board because I feel that it is easier to look up the answers to your own questions rather than rely and wait on someone else to answer them. If you just look up your question on the internet, you have an unlimited supply of information at your disposal and you can extract the amount or sections that apply to you. You also can access them at your own time, at your own pace. In addition, if you are on a roll of good solid work, it is difficult to get break away, go to blackboard, post, and then wait for the answer to continue working. If I were to just wait for answers, I do not think I would get much done if I set myself a certain amount of time for this subject. “

On the other hand, a few students noted that it was easier for them to use the discussion board because it was more specific and personal to their own needs, as opposed to books or the Internet which offered more general information.

### *Attitudes Toward Discussion*

The focus of attitude in this study is focused on perceived usefulness of the discussion board. In the post task survey, over one third of the students thought the discussion board was an effective learning tool (n= 24/65; 37%). With respect to actual use, 38% of the students used the discussion board frequently, 25% occasionally, and 27% not at all. Almost two thirds (65%) of the students reported that they had received useful information, while one third (39%) thought they had provided helpful information. Eight-two percent of the students did not indicate grade as a key motivator for participating in the discussion board.

### *Response Time*

The average time taken to respond to a message was 3630 minutes or two and half days (SD = 7338 min). Students responded as quickly as one minute and as slowly as 34 days. After eliminating outliers (e.g., response times greater than 10000 minutes or one week, n=22 messages), the average response time was 1519 minutes or about one day (SD = 2204 min). Response time appears to jump after the third message from 1182 minutes (19.7 hours) to 1853 minutes (31 hours) for the fourth message, although the sample is too small to reliably assess statistical significance.

Response time is significantly and negatively correlated with the number of times a message is read ( $r = -.254$ ;  $p < .01$ ). In other words, the longer it takes for someone to post a reply, the less likely it is that the new message will be read.

### *Learning Outside Of School*

Just over half ( $n=142$ ; 55%) of all messages posted on the discussion board were completed outside of school hours. There were no significant differences between school and home messages with respect to clarity of subject line, message quality, response, time, and number of words, however messages posted at home were rated as more difficult to answer than messages posted in school ( $p < .05$ ).

### *Performance and Discussion Board Participation*

Learning performance for both HTML and beginning programming topics were positively correlated with number of visits, numbers of days visited, and number of messages posted, with one exception - the number of visits the HTML discussion board was not significantly correlated to the final web page project grade (see Table 2).

The results above are supported by the post task survey where over one third of the students reported learning significant concepts using the discussion board ( $n=24/65$ ; 37%).

## Discussion

### *Overview*

Overall, secondary students learning HTML and beginning programming were relatively successful at using the discussion board. While discussion threads were short with respect to average number of messages and words written compared to those posted in higher education

(e.g., Hara et. al, 1998), the focus of the board examined in this study was to answer specific, application oriented questions. Higher education discussion boards are typically aimed at higher level issues.

Nonetheless, messages were read frequently and typically responded to within a day. The discussion board was content focused with very few non-academic messages. Finally, a majority of students reported actively using the discussion board to supplement their learning, a perception that was supported by significant correlations between discussion board participation and final grades in both HTML and beginning programming

#### *Social Learning, Cognitive Processing and Learning Performance*

There is clear evidence that students were genuinely engaged in social activity. Many discussion threads exceeded 5 messages, and a majority of posts consisted of specific responses to fellow student's comments and problems. As well, roughly one third of all students participated in the same discussion thread at least 2 or more times, a pattern not found in higher education students (e.g., Hara et. al., 1998).

Social "activity" does not necessarily guarantee that social "learning" is taking place (e.g., Berge & Muilenburg, 2000; Hara et. al., 1998; Son, 2002; Wickstrom, 2003). The analysis of the discussion board messages in this study, though, suggests that students were actively and cooperatively trying to understand and apply new HTML and programming concepts. However, metacognition, analysis, and evaluation were not observed often. This later result is partially predicted by Piaget (1954, 1974), who notes that formal operations may not occur in younger students. Case (1992, 1998) suggests that abstract thinking, indicative of the formal operations stage, might be accelerated if a student acquired more advanced knowledge of a particular topic.

However, the two topics taught in this study were introductory in focus and it is unlikely that many students had a highly developed knowledge base. One other explanation for the absence of higher level knowledge and processing might rest in the task oriented nature of the curriculum. Students were primarily focused on learning specific ways to do particular procedures, not reflecting about the process.

The final piece of evidence to suggest the existence of social learning was the positive and significant correlation between discussion board participation and performance in the course. Students who participated regularly in the online discussion performed better than students who were not involved.

Overall, the revised Blooms taxonomy from Anderson and Krathwohl, (2001) proved to be a useful and theoretically sound metric in systematically assessing the quality of learning in the discussion board. The observations gathered from this measure were consistent with the knowledge level addressed by the curriculum and previous research on learning development (e.g., Piaget, 1954, 1974; Case, 1992, 1998).

### *Quality of Discussion*

Past research in higher education has suggested that if a discussion board is to be successful, there is a need for controversial and thought provoking topics to promote higher level thinking and active discussion (e.g., Blignaut & Trollip, 2003; Burstall, 2000). The results of this study suggest that there may be another role for discussion boards, one that supports more application focused, concrete dialogue. Students learning HTML and beginning programming were able to post and answer meaningful factual, conceptual and application based knowledge problems leading to improved learning performance. Students also posted relatively clear and

unambiguous messages, a finding that was not observed by Knowlton & Knowlton (2001) or Love (2002).

### *Initial Question*

A detailed analysis of the initial question starting off a discussion thread, based on subject line clarity, difficulty of the topic addressed, message quality, and level of cognitive processing, revealed no significant differences with respect to how often messages were read or the length of the discussion. It appears for the topics looked at in this study (HTML and programming) and the type of students (secondary level), there are no distinct characteristics of the initial question that encourage more participation. This finding is inconsistent with previous research (e.g., Berge & Muilenburg, 2000; Hara et. al., 1998; Savage, 1998), although it is somewhat difficult to compare given the absence clearly defined assessment tools prior to this study. The results should be interpreted with caution because only 44 discussion threads were analyzed.

### *Role of Educator*

The teacher in this study did not dominate or excessively stimulate discussion. Students initiated and ended the vast majority of discussion threads. This approach is consistent with the “guide on the side” philosophy advocated by Burstall (2000), Li, 2003; and Mazzolini & Maddison (2003). As stated earlier, students were not only successful at interacting and building new knowledge, but their participation contributed to better performance on finals projects and tests. This result does not preclude the possibility that they could have performed even better if the teacher had taken a more active role. It does indicate, though, that students are capable of taking responsibility for a discussion and learning new facts, concepts, and applications without

significant teacher intervention and participation. Since much of the knowledge covered in the discussion board went beyond the standard curriculum and students participated in discussion outside of class more the fifty percent of the time, the online discussion board has the potential to be a powerful supplement to a traditional classroom format.

### *Navigation*

Navigation issues were reported by students as the number one impediment to using the discussion board. Somewhat surprisingly, subject line clarity, which is the only initial guide to directing users in an online discussion board, was not significantly correlated with whether a message was read or how fast the message was responded to it. However, messages at the end of long discussion threads were read less. This latter finding supports the claim that the large number of entries in a discussion thread can inhibit active participation.

The reading rate dropped sharply after the first message, and then declined at steady rate. Two critical questions that still need to be answered are how many messages are users willing to read within a specific discussion and why to they stop reading.

Chen and Hung's (2002) speculation that the traditional online discussion format is limited with respect to supporting true and personal knowledge building was not supported by the current results. As stated earlier, students, in spite of the navigation issues, managed to participated regularly and learn effectively. Nonetheless, features such as notifying the author of a message when there is a response to that message or specific prompts to encourage knowledge building may improve learning (Scardamalia & Bereiter, 1999).

### *Challenges for Students*

Secondary students experienced some of the same challenges as their higher education counterparts: reticence to use the discussion board (over 25% percent of all students posted two or fewer messages), time challenges, lack of organization, and the negative effect of being graded. While the discussion board was use frequently and improved learning for many students, there are noteworthy obstacles in using this tool.

### *Types of Users and Attitude Toward Use*

To date, individual differences in using a discussion board have not been looked at in a comprehensive way, although anecdotal evidence suggests that students assume specific roles (e.g., Hammond, 2000; McGrath & Hollingshead, 1994; Palloff & Pratt, 1999; Wickstrom, 2003). The results from the current study support previous anecdotal observations. Students in this study could be significantly differentiated based on number of messages they read, how fast they responded to messages, number of words they wrote, and the overall quality of their messages. These measures, when viewed as a whole, could be seen as a reflection of general enthusiasm for using discussion boards. In other words, students who read messages more, respond to messages quickly, and write detailed, high quality messages could reasonably be considered as enthusiastic participants. Not reading or responding to messages or providing short, one sentence messages might be a reflection of apathy.

The results for identifying distinct qualities of discussion board users, is consistent with students' attitudes toward use. Roughly one third of all students said they used the discussion board sparingly or not at all. They noted that either the discussion board did not match their personal style of learning or that there that they thought there were more efficient ways for them

to learn (e.g., using a book, talking with someone, using the Internet). Another third of all students appeared to have an indifferent attitude using discussion board on occasion. The final third were enthusiastic participants who received and offered new ideas frequently.

These differences in use and attitude should be noted by educators. While some students may thrive with this tool, others need more convincing or may not be prepared to use the discussion board at all.

### *Response Time*

While response time has not been formally examined previously, the results of this study support Son's (2002) speculation that delays in responding to messages could have a negative impact. Students responded relatively quickly to the first three messages, after which the response time jumped by over fifty percent. When you consider the significant and negative correlation between response and number of times a message is read, response time becomes even more critical. In other words, there appears to be a window of opportunity, roughly 19 hours, in which students will follow up on a discussion board message, after which they start to lose interest.

This kind of result may be unavoidable with traditional discussion board format which is relatively flat and serial. Chen and Hung (2002) proposed a new feature where students have the ability to electronically indicate interest in a specific message and then are automatically informed of any future messages linked to their interests. This kind of tool might get users to return to a discussion, after several days or weeks. It is worthwhile to note, that without prompting, some students will post messages a week and even a month after the original

discussion was started, but that these messages are rarely read. The prompting mechanism suggested by Chen and Hung (2002) could improve reading rates and participation.

### *Learning Outside of School*

The discussion board in this study was used as a supplement to teaching a secondary course in HTML and programming and students were willing to use it outside of school hours. This result is even more powerful given (a) a majority of the topics covered on the discussion board went beyond the curriculum and (b) use of the discussion board was significantly correlated with learning performance. In fact, more difficult topics were discussed at home.

Successful, meaningful, and effective use of discussion boards outside of school hours could prove to be beneficial to educators in at least two ways. In large classes, it is often not possible to answer the range and number of questions during class -- the discussion board clearly augments this process.

### *Summary*

The students in this study used the discussion board to actively understand and apply new concepts and procedures related to learning HTML and programming. The majority of students posted clear, good quality messages that covered material that went beyond the standard curriculum. Discussion occurred outside of school hours on a regular basis. The quality of questions starting off a discussion did not have a significant impact on participation. The role of the educator was minimal and unrelated to participation or quality of the discussion board. The number one challenge students experienced were problems due to navigating the large number of messages. Students could be differentiated on their level of participation and attitudes toward using the discussion with one third being enthusiastic, frequent participants, one third occasional

and indifferent, and one third participating infrequently, if at all. Long delays in responding to messages had a significant, negative impact on how often subsequent messages were read. Finally, and perhaps most important, participation in the discussion board had a significant, positive effect on learning performance.

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Table 1  
Variables Used to Analyze Discussion Board Messages

Variable	Description	References
Topic	HTML or Programming	None
Thread	A thread is a collection of messages on a specific topic	Mazzolini & Maddison, 2003
Message Number	Identifies where a message is posted within a specific thread	Mazzolini & Maddison, 2003
Author	Instructor vs. Student	Henri, 1992; Hammond, 2000; Hara et. al., 1998; Love, 2002; Mazzolini & Maddison, 2003 Zhu, 1998
Subject Line	Heading at the top of each message Unclear (0) to Very Clear (3)	Hara et. al., 2003
Posted When	Within vs. outside of school hours	None
Response Time	Time taken to respond to last message in a thread Collected using Blackboard	None
No. Times Read	Number of times a messages was read Collected using Blackboard	None
No. Words	Number of words in a message	Hammond, 2000; Hara et. al., 1998
Primary Purpose	Open or specific question, answer, independent comment, non academic, offering information	Blignaut & Trollip, 2003; Henri, 1992; Son, 2002; Zhu, 1998
Message Quality	Ranging from Incorrect (0) to Excellent (4)	Love, 2002
Message Difficulty	Specific content ranging from easily answered (0) to easily answered (3)	None
Course	None, Administrative, Course	Hara et. al., 1998; Love, 2002;

Knowledge	Related, Beyond Course	Son, 2002;
Knowledge Type	Fact, Concept, Procedure, Metacognitive	Anderson & Krathwohl, 2001; Hara et. al., 1998; Henri, 1992;
Processing Level	Remember, Understand, Apply, Analyze, Evaluate, and Create	Anderson & Krathwohl, 2001; Hara et. al., 1998; Henri, 1992;
External Resources	Reference to external sources (e.g., books, internet, teacher, other messages)	Love, 2002

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Table 2.

## Correlations Among Discussion Board Participation and Learning Performance Measures

	HTML Final Project	HTML Final Test	Programming Final Project	Programming Final Test
Number of Visits	$r = .27$ (n.s.)	$r = .44$ ( $p < .01$ )	$r = .33$ ( $p < .05$ )	$r = .38$ ( $p < .05$ )
Number of Days Visited	$r = .42$ ( $p < .01$ )	$r = .48$ ( $p < .01$ )	$r = .36$ ( $p < .05$ )	$r = .36$ ( $p < .05$ )
Number of Posts	$r = .31$ ( $p < .05$ )	$r = .44$ ( $p < .01$ )	$r = .33$ ( $p < .05$ )	$r = .35$ ( $p < .05$ )

Note: n.s. - not significant

Figure Caption

*Figure 1.* Reading Rate by Message Number

Figure 1

Reading Rate by Message Number

