E-mail discussion and student learning outcomes: A case study

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E-mail discussion is widely used in university courses and is being increasingly adopted in K-12 education. However making educational value from the massive amounts of e-mail transcripts that can be generated is a problematic task. It is important in an environment of constrained teaching resources that computer driven methods be developed to evaluate effective learning processes. A critical starting point is the relationship between messaging and student learning outcomes. This paper examines student learning outcomes and learning behaviours over three years of an education degree course involving e-mail discussion technology. It documents a clear relationship between the number of messages sent by students through e-mail discussion and the final grade for this course. Normative behavioural patterns that are evident from the transcript data can assist in ongoing educational monitoring.

e-mail, collaborative learning, interactive, Internet, evaluation.

INTRODUCTION

With the increased complexity of the online environment, educators are seeking ways to effectively utilise available technologies for quality teaching and learning. There are a number of factors, such as the type of activity and the assessment requirements that can impact on their effectiveness. Interaction and collaboration have been recognised as key ingredients in the learning process where students are not only active and supportive, but also interactive (Kirby, 1999; Hiltz, 1998; King & Doeffert, 1996). In collaborative learning environments students are actively engaged in supporting each other in the development of higher level reasoning strategies, critical thinking, hypothesis formation and reflection. Email discussion groups can be implemented to support collaborative and discursive interaction. A number of theoretical perspectives, with their foundations in cognitive developmental, behavioural and social interdependence theories (Johnson & Johnson, 1996) are guiding the design of courses and our understanding of how students learn.

Extensive research has shown the capability of computer-mediated communication to engender quality learning (Sringram & Geer, 2000; Newman et al., 1997; Gunawardena et al., 1997). More recently Geer & Barnes (2001) have developed rapid sampling techniques to identify metacognitive processing within textual discourse. A major thrust of that research was to provide an analysis of the content and interaction of the participants; and to identify indicators of cognitive and metacognitive learning that demonstrated the presence of quality learning. Such detailed analysis is very time consuming and not always practical during the duration of the course. With an overwhelming quantity of discourse being generated and the time that is required for a detailed analysis of the discourse, educators need to find ways that can readily give them a sense of the educational quality of the discourse so that strategic intervention can...
take place if needed. Are there methods then, that can be used with email discussion technologies that can give an indication that students are learning through engagement with the course content?

The following Model of Technology-Mediated Interaction (Figure 1), in the shape of a pyramid, attempts to show a progression in the levels of interaction that show a shift from surface to deep learning (Ramsden, 1992). It has been developed in order to explain the relationship between types of interactivity that can occur in the online environment and the suitability of various technologies to support interaction and the associated learning outcomes. Each level denotes a type of interaction that might be expected in relation to specific teaching and learning approaches. There are many factors or drivers that can impact on the effectiveness of the interaction and assessment has been shown to be one of the factors that have a strong impact on learning outcomes. The intention of this model is to provide a conceptual framework, in which you can identify the entry point of the type of interaction required, utilising the various technologies that support such a level and ensuring that relevant learning outcomes are being achieved.

![Model of Technology-Mediated Interaction](image)

*Figure 1. Model of Technology-Mediated Interaction indicates the hierarchies of interaction, technologies and learning outcomes, together with the influential drivers affecting learning outcomes.*

**BECOMING INFORMATION LITERATE: THE COURSE AND ITS CONTEXT**

There have been a series of initiatives over the past few years in the course, Becoming Information Literate (BIL) to enhance learning outcomes, develop greater independence in students and improve the efficiency of teaching and delivery through the use of email discussion lists. The focus is on the development of effective computer skills, the integration of learning technologies into the curriculum and the opportunity to analyse underlying conceptual and educational issues. Email discussion lists have been closely embedded into the course assessment, as it was felt mandatory learner participation and interaction would increase the engagement with the course content through the development of the higher cognitive thinking
skills. It has provided the opportunity for student interaction to take place at any time and offered students the flexibility of time, place and pace in which to reflect and respond to topics and questions.

BIL is a core first year course within the Bachelor of Education program. Students are organised into tutorial groups of about 20 students and allocated to email discussion lists according to their tutorial groups. Approximately every three weeks students are assigned a topic for discussion via their email lists. Based on their readings in the area, students are expected to post reflective comments of 300-400 words in response to the topic to their assigned email discussion list. The responses are not marked as such, but they are a mandatory requirement of the course. Students did not have to give their response as a single message, but their feedback may span a number of messages. The majority however did provide an initial single message response to all the topics. As well as responding to the topics, students are assigned to a small collaborative group where they given responsibility for one of the discussion topics. Their task is to identify and summarise the key issues raised through the discussion lists and to present these in a face-to-face tutorial session. This encourages further interaction as the small group is challenged to critique the responses of their colleagues. It was felt that the instructional design would encourage increased interaction and collaboration. These strategies have been recognised as desirable ingredients in a learning community, as well as an essential quality in the social context. Based on the pyramid cited above it was also anticipated that students through their discussion would demonstrate processes of interpretation, experiential learning, analysis and exploration. It is recognized that associated learning benefits are closely tied to the assessment requirements.

E-MAIL TRANSCRIPTS AND STUDENT LEARNING BEHAVIOURS

Email transcripts from these discussions have been collected over the past three years resulting in approximately 2 megabytes each year of original e-mail discussion transcript. In the last two years a web archive has been made available providing increased flexibility. Students have also been able to use multiple e-mail aliases. Basic statistics on the e-mail traffic and length of messages are displayed in Table 1 below.

<table>
<thead>
<tr>
<th>Year</th>
<th>Students</th>
<th>Messages</th>
<th>Total</th>
<th>Mean</th>
<th>Words</th>
<th>Total</th>
<th>Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>1999</td>
<td>253</td>
<td>1150</td>
<td>4.55</td>
<td>460,023</td>
<td>1818.27</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2000</td>
<td>186</td>
<td>1010</td>
<td>5.43</td>
<td>307,815</td>
<td>1654.92</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2001</td>
<td>213</td>
<td>1386</td>
<td>6.51</td>
<td>402,989</td>
<td>1891.97</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

There are no apparent differences in the number of messages or the message length by males and females in any of the years. However there does appear to be two different types of messages that can be identified by different characteristic lengths (Figure 2).

Students are encouraged to use the medium to increase their social comfort and to explore its possible potential. There are a considerable number of shorter messages, which can be associated with socialising, exchanging information, organising, and clarifying expectations. The other group of messages can be identified as the mandated contributions from each student. This group is almost symmetrically distributed about a mean of 425 words, which corresponds to assessment requirement of 400 words for each contribution. Both BIL 1999 and BIL 2001 show similar bi-modality to BIL2000.
The impact of the assessment driver on transcripts is further demonstrated in Figure 3 where the peaks correspond to due dates for e-mail contributions. Such information could be used as a running analysis tool to check that responses have been sent on time. Lateness in submission impacts on the ability of the small group to summarise and critique the responses sent by peers.
The timing of e-mail submissions during the day illustrates the working behaviours of students. Approximately 75% of e-mail traffic is sent outside of formal tutorial times. This is a pleasing result as students are recognizing the need to focus on the planned activity for that session rather than being distracted by the need to submit their response during the tutorial session. Predominantly for this campus based course e-mail is sent between the hours of 9am and 2pm. However there is still considerable activity outside of the 9-5 working day with over 25% of e-mail messages being sent after hours. The following graph provides a clear picture of the email habits as messages sent during the tutorial sessions have been eliminated. There is a similar pattern of behaviours across each year. Over the three years the use of external mail providers has increased, almost doubling to some 10% of messages for BIL2001.

Figure 4. The graph shows the frequency of e-mail each hour around a 24-hour clock. This is for BIL 2001 and shows e-mail sent only outside of the standard tutorial times

At the time of analysis there appears to be no identifiable relationship between time of day and the size of the message. However with further analysis we may find that it reflects particular individual study habit behaviours.

E-MAIL TRANSCRIPTS AND STUDENT LEARNING OUTCOMES

In previous studies the authors and others have examined the discourse content of email transcripts for evidence of learning. More rapid techniques have been developed for identifying key individual and group metacognitive activity (Geer and Barnes, 2001), however these remain tedious and at best could only practically be used as sampling techniques to provide some assurance that learning is taking place. On the other hand a study of summative learning outcomes and their relationship with messaging can provide a picture of expected behaviour in a given course like BIL.

The following table shows the correlations between the summative grade for students in each of the BIL years and the frequency and size of messages.
There appears to be a positive relationship between the overall learning outcomes for the BIL courses and messaging frequency. Generally better students are mailing more frequently and gaining more marks than others, even in the context that such mailing is not directly assessable. Figure 5 displays this relationship in graphic form for the BIL 2000 class.

Moreover the size of this relationship is fairly constant over the three years of the course, as demonstrated in the table of regression coefficients below. Student messaging behavior can thus provide an explicit measure of "time on task" and be used as a proportional indicator of student learning performance. It provides an extra formative tool beyond that of summative assessments to assist instructors in managing their students.

Figure 5. The linear regression line for the number of messages sent (independent variable) and the student learning outcome in the course as measured by the final mark (dependent variable).
<table>
<thead>
<tr>
<th>Year</th>
<th>Statistic</th>
<th>Unstandardized Coefficients</th>
<th>95% Confidence Interval for B</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N</td>
<td>F</td>
<td>Sig.</td>
</tr>
<tr>
<td>1999</td>
<td>253</td>
<td>14.98</td>
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</tr>
<tr>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
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<td>13.06</td>
<td>0.0004</td>
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<tr>
<td></td>
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<td></td>
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<td>12.7</td>
<td>0.0005</td>
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</table>

CONCLUSION

The BIL case study over three years shows a consistent picture of message behavior and learning outcomes. The positive relationship between messaging frequency, message length and summative learning outcomes provides confidence in the effectiveness of the teaching strategies involved. Student messaging behavior made visible in the e-mail record can be used as a formative indicator of time on task and learning quality. Such computer-automated measures can provide guidance for instructors on student progress.

REFERENCES


Kirby, E. (1999) 'Building interaction in online and distance learning’, Unavailable URL, see sourced at ekirby@westga.edu

