A Performance Indicator for Students' Discussion in Internet Forum for Information Systems Education

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ABSTRACT

Students discussion in an Internet forum when working on a project for Information Systems (IS) courses is common in Malaysia. Assessing students' contributions to Internet forums have become an important task. One of the main reasons for assessing students' contribution is to ensure student's discussions are focus on the topic. However, to accurately assess students' contributions to Internet forums is a time consuming task. SCAFFOLD (Scale for Forums/Online Discussion Assessment) was adopted to ease the process of categorizing and describing contributions. A performance indicator using several assessment criteria to assess students' contribution was proposed to implement in an Internet forum. This paper reports the implementation of a performance indicator results from the findings of a survey on the requirements for assessing students' contributions to Internet forums for IS education. The survey and the evaluation of the performance indicator were carried out in Malaysia.

Key Words: Information systems education, Internet forum, assessing students' contributions, performance indicator.

1. Introduction

Information Systems (IS) as a field of academic study encompasses the concepts, principles, and processes for two broad areas of activity within organizations: acquisition, deployment, and management of information technology resources and services (the information systems function); and development, operation, and evolution of infrastructure and systems for use in organizational processes (system development. system operation. and system maintenance). The academic content of an IS degree programme therefore includes information technology, information systems management. information systems development and implementation. organizational functions. and concepts and processes of organizational management [1]. For students pursuing their degree under IS courses, project or assignment is one of the course component that students have to complete. Students discussed their learning issues in Internet forums when working on a project or assignment is common for IS courses. Students discussion in an Internet forum is important as it is difficult to schedule for regular project meeting and discussion shall not be limit to project meeting. In an Internet forum, each student can view another student's contributions and learn through the exposure to different perspectives and providing feedback to one another online. The process of reflection and articulation of content, writing about what they have learned engages students in an activity learning experience. Permanent storage of messages in an Internet forum provides support for reflection. Moreover, educators usually did not provide enough feedback for their learners to complete their project [2]. Assessing students' contributions to Internet forums have become an important task. The two main reasons for assessing students' contributions are to encourage students' participation, and to ensure student's contributions are focus on the topic given. Student participation is a key to effective collaborative learning [3]. The research findings indicate that students need to be active participants in order to succeed. Besides, assessment criteria can served as a clear guide to students for learning outcomes and the expected quality of thinking and work, and as a means of aligning teaching and learning behaviours and goals [4][5].

There is a number of assessment criteria stated in the literature such as assess students' performance based

on total number of students' postings, total message length, timeliness of message, describing and categorizing postings using SCAFFOLD (Scale for Forums/Online Discussion Assessment) [6], and content analysis using Henri's Analytical Model [7] and Garrison and Anderson's Practical Inquiry Model of Cognitive Presence[8]. However, to accurately assess students' contributions to Internet forums is a time consuming task as reported in literature.

To minimize the time for assessing students' contribution to Internet forums, a computer generated performance indicator (PI) is proposed. A computer generated PI calculated based on some assessment criteria to evaluate the students' contributions.

This paper starts with a description on assessment criteria used for PI calculation. It then followed by a summary of the survey on the requirements to assess students' contributions to an Internet forum. It continues with the implementation of the PI, the evaluation of PI and its limitations. The paper concludes that the PI can be used as a second grader for students' contribution to Internet forum.

2. Performance Indicator

The objective of PI is to predict students' marks by analyzing the class messages posted by IS students in Internet forums. The PI is generated from four aspects: the quality of their work, the quantity of their efforts, the timeliness and the activeness of their participation. Four measures – message category, message length, message date and number of messages – are derived from the class messages to measure each assessment aspect respectively.

The researcher assumes that quality of learning in Internet forums is revealed by the quality of the messages generated by a student. The category of a message is analyzed along SCAFFOLD to reflect the depth of knowledge level of the author, so the message category could be an indicator for the learning quality. SCAFFOLD is recommended for categorizing messages since it items contains the elements of the highest level of knowledge that is analysis, synthesis, and evaluation. These highest level of knowledge is important as IS academic community emphasized the importance of developing students' problem solving and critical thinking abilities as the exit characteristics of its IS. SCAFFOLD is build upon the theoretical foundation established in the literature. Dringus and Ellis summarised a range of participation indicators identified in the literature (including models for analyzing the process of learning in Internet forums such as Garrison, Anderson, and Archer's Practical Inquiry Model of Cognitive Presence, and Jeong's sequential analysis of group interaction and critical thinking in online discussion) and develop a list of 19 participation indicators[6]. SCAFFOLD was used by faculty and students to rate the 13 postings contained in a discrete segment of a masters-level discussion forum in a multimedia systems course [9]. The results of evaluation shows that SCAFFOLD could be used for developing and conveying feedback on Internet forums. An approach to resolve the challenges of collecting and coding large data sets might be to directly involve students in a process of categorizing their own discussion in such context. Kowlton argues that "For the benefits of online discussion to be realized, students must have formal opportunities for evaluation"[10]. Students must practice self evaluating their own contributions to an online discussion against a clearly articulated set of criteria.

Knowlton emphasized on the important of giving a minimum length for postings since it takes some length to construct perspectives that can become the basis of knowledge[10]. Therefore, students' effort in the virtual dialogue could be reflected by the amount of words they post to the system. Message length measure is defined to measure a student's effort in the class by counting all the words; no matter duplicated or not, in the student's messages. The minimum length requirement assures that students are spending time to become engaged.

In terms of timeliness, due dates were best for stimulating the discussion online. It is important that messages are posted or reply on time [9][10][11].

Student participation is a key to effective collaborative learning [3]. If posting a message is considered as one class activity, activeness of participation can be measured by message count, which is the number of messages posted by a student.

Combining the assessments from multiple aspects has been proven useful for increasing the forecast accuracy[12].

The authors apply the idea of weighting to assign weights to assessment criteria. The four measures are combined to compute a PI score, which is

PI score = a*Tot_Mess + b*Tot_Length + SCAFFOLD;

So, after replacing SCAFFOLD with it's elements,

PI score = a*Tot_Mess + b*Tot_Length + c* Count_ Acknowledging + d*Count_ Analysis + e*Count_Broadened + f*Count_Evaluative + g*Count_Clarification + h * Count_Questioning + j*Count_Resolution + k* Count_Resources + m*Count_Social + n*Count_Summarzing +
p*Count_Synthesis;

Where

a, b, c, d, e, f, g, h, j, k, m, n, p are coefficients, Tot_Mess - Total message posted Tot_Length – Total message length Count_ Acknowledging frequency of _ "acknowledging" message Count_ Analysis - frequency of "analysis" message Count Broadened - frequency of "broadened" message Count_Evaluative frequency of "evaluative" message Count_Clarification - frequency of "clarification" message Count_Questioning - frequency of "questioning" message Count_Resolution - frequency of "resolution" message Count Resources - frequency of "resources" message Count_Social - frequency of "social" message Count Summarzing - frequency of "summarizing" message Count_Synthesis - frequency of "synthesis" message

For timeliness of posting, a date is required so that the formula only include those messages that fall before the date stated for calculation of the PI.

3. A summary on a survey finding

The authors have conducted an electronic questionnaire to seek the opinion of IS educators in Malaysia on the needs of having a computer generated PI, the assessment criteria used in a PI and the supporting function required to operate with a PI. Thirteen out of seventeen public universities listed in the homepage of Ministry of Higher Education Malaysia that offer IS courses to their students were agreed to participate in this study[13]. IS courses are offered in a traditional face to face teaching method in these universities. A total of 178 electronic questionnaires were transmitted and 73 usable sets were returned. Thus, the respondents represent about 41% of total IS educators from the thirteen universities.

The respondents were asked if it would be useful to have an Internet forum that can generate PI scores for students' online contributions. 95.9% of the respondents agreed. The respondents were given a list of criteria that the respondents can select to use in a PI, 67.1% of the IS respondents would like the "timeliness of posting" be a criterion in a performance indicator. "Categories of posting using SCAFFOLD" and "Number of discussion posted" were selected by 58.9% and 56.2% of the respondents as criteria used in a PI. "Length of posting" was selected by 24.7% of the respondents. All the IS respondents wanted to assess students' contribution where none of the IS respondents selected the NONE option as shown in figure 1. However, the figures indicated that the criteria in a PI is and will remain as a subjective option of the IS respondents. The respondents were asked how PI scores should be presented. According to the analysis as shown in figure 2, 84.9% of the respondents selected "Rank based on predefined criteria used in a performance indicator". 42.5% of the respondents opted "Filter to view only a group of students". 27.4% of the respondents selected "plain text or comma delimited format exportable for further processing". The respondents were then asked which of the given features that would help to motivate students' contribution to Internet forums for IS education. 79.5% of the respondents selected "a performance indicator score for each individual student". 64.4% of the respondents selected "frequency on the criteria used in a performance indicator". 46.6% of the respondents selected "Self categorize posting" (figure 3).



Figure 1 Analysis of Responses for assessment criteria for a PI



Figure 2 Analysis of Responses for presentation of PI scores for IS educators



Figure 3 Analysis of Responses for features that help to motivate student's contribution

4. Implementation of a performance indicator

In order to implement a computer generated PI, open source forum software was adopted. Open source software (OSS) projects are managed by a large number of volunteers or developers, working freely on the tasks they choose to undertake. After reviewing the list of forum software [14], class-1 Forum Software is adopted in this research. class-1 Forum Software is written and distributed under the GNU General Public License which means that its source is freely-distributed and available to the general public. Using OSS approach, the authors do not need to redevelop the basic features available in existing Internet forum. However, the authors need to study the flow of the program and database design of the adopted Internet forum in order to understand the forum software. Forum software benefits to implement event driven programming because they suit the inherently event-driven nature of many aspects of the real world. Class-1 Forum Software is an event driven software. Event-driven programs typically consist of a number of small programs called event handlers, which are to be called in response to external events. The external events might be a keyboard or mouse operation, or a timer event.

Class-1 forum software is a linear forum where each message is added onto the end of the discussion. For members or students, the forum software supports the standard capabilities to post a new message, reply to a message, and follow threads. Class-1 forum software supports other features such as user-selectable theme, image attachment, and full unread message tracking. The instructor act as an administrator, that has the ability to ban user, perform user grouping and searches. Students have members' role in the forum software. Class-1 forum software does not support assessment features.

The following subsection discusses the key features identified in the previous section for assessing students' contributions to Internet forum. The key features added were students' message categories statistics, group performance statistics, set PI, file with comma delimited format for further processing, student self categorize messages and my posts summary. The authors choose to discuss the insertion of new features from the user interface perspective of class-1 forum software.

4.1. Members or Students Interface

The new features that added to members interface were self categorize posts for participation in an Internet forum and my post summary. To implement the proposed features, SCAFFOLD checkbox is developed to allow members (student) to categorize his own message before posting as shown in figure 4. The post category is captured by the forum software and store in the database. A student can click on the "My posts summary" (located at the top right hand corner) to view his performance statistics such as the frequency of message category, number of messages, length of messages as well as a PI score for each forum as shown in figure 5. "My post summary" displays the statistic for message posted by the student and overall class discussion performance.

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Figure 4: Screen capture of "post new message" interface

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| | My Posts Summary | | | | |
| | Forum: project 1 Discussion issue on project 1 | | Overall | | |
| | Latest Post | 07 Dec 2006 | 07 Dec 2006 | | |
| | Total Posts | 1 | 18 | | |
| | Total Message Length | 7 | 83 | | |
| | Posts Category | count | | | |
| | Acknowledging | 1 | 4 | | |
| | Analysis | 1 | 3 | | |
| | Broadened | 1 | 3 | | |
| | Clarification | 1 | 3 | | |
| | Evaluative | 1 | 3 | | |
| | Questioning | 1 | 4 | | |
| | Resolution | 1 | 4 | | |
| | Resources | 1 | 3 | | |
| | Social | 1 | 6 | | |
| | Summarizing | 1 | 3 | | |
| | Synthesis | 1 | 3 | | |
| | Performance indicator score | 9 | | | |
| | Forum: Project 2 | | Overall | | - |
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Figure 5 Screen capture of "My posts summary" interface

4.2. The Administrator Interface

IS educators can access to administrator interface and member interface. The new features that added to administrator interface were set performance indicators, students' messages categories statistics, export file with comma delimited format for further processing, and group performance statistics. To implement the proposed features, the forum software should enable administrator to set the coefficient for the criteria of the PI for each forum. Coefficients that can be set in a PI are total message, total message length, and each category of SCAFFOLD as reported in a survey findings. Each criterion is given a coefficient to be filled in by an IS educator (figure 6). This feature allows the IS educator to select the preferred grading criterion as the criteria in the PI is and will remain, in a large way, a subjective option of the IS respondents. A zero coefficient for a criterion indicates that the IS educator does not used it as a grading criterion. A criterion that is preferred to use as grading criterion by the IS educator could be given a higher coefficient value. Once the coefficients are set, it applied throughout the forum. For timeliness of postings, a date is required so that the system only

include messages that fall before the date stated for calculation of the PI. The formula used here is

PI score = a*Tot_Mess + b*Tot_Length + c* Count_ Acknowledging + d*Count_ Analysis + e*Count_Broadened + f*Count_Evaluative + g*Count_Clarification + h * Count_Questioning + j*Count_Resolution + k* Count_Resources + m*Count_Social + n*Count_Summarzing + p*Count_Synthesis;

Where a, b, c, d, e, f, g, h, j, k, m, n, p are coefficients, Tot_Mess - Total message posted Tot_Length – Total message length Count_ Acknowledging frequency of _ "acknowledging" message Count_ Analysis - frequency of "analysis" message Count_Broadened - frequency of "broadened" message Count_Evaluative - frequency of "evaluative" message Count_Clarification - frequency of "clarification" message Count_Questioning - frequency of "questioning" message

Count_Resolution - frequency of "resolution" message

Count_Resources - frequency of "resources" message Count_Social - frequency of "social" message

Count_Summarzing - frequency of "summarizing" message

Count_Synthesis - frequency of "synthesis" message

Even though students are allowed to categorize their own message category, students can not edit or delete message after posting. IS educator can perform edition or deletion of messages. The IS educator can change the category of the message if found incorrect.

IS educator is able to export the data about students' performance for selected forum if required. The output file is a comma delimited file contains

username, forum name, the frequency of the criteria used in the PI and the PI score. This enable the IS educator to use the file to perform further processing using other application software such as Microsoft Excel or statistical software such as SPSS.

IS educator is able to view all forums' messages statistic. The statistics include total number of message and count for each SCAFFOLD categories for each forum. The statistics also include each student's total number of message posted, total message length, count for each SCAFFOLD categories and PI score. The report is able to display ranking based on the criteria used in the PI. IS educator could know the discussion categories activity among students with this feature.

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Figure 6 Screen capture of "Set performance indicator" interface

5. Evaluation of the performance Indicator

The main purpose of the evaluation is to determine the accuracy of the assessment model in predicting student mark for their contributions to Internet forum in teaching and learning of IS. To measure the accuracy of the assessment model, Pearson productmoment correlations between the PI scores and the actual grades were calculated. The evaluation of the forum software was conducted in the second semester of an academic year. Two IS educators from Faculty of Computer Science and Information Technology of the oldest university in Malaysia (named UNI X) were agreed to participate in the evaluation of the forum software. Two IS courses (identify using ID = W1 and W2) with a total of sixty four (not seventy because six students took both courses) students from UNI X were involved in the evaluation. The students were taking IS courses that required them to complete a project; hence they had a suitable background for the evaluation. At the end of the project duration, all the IS students' discussions were compiled into tables. Each table contains posts detail such as posts' subjects, time and date of posts, and aggregate contribution of a student in the forum software. If thirteen IS students participated in the discussion forum, then thirteen tables contain posts detail of the IS students involved were created for assessment. The administrator took two hours to compile the forum data into tables. The compiled data files were sent to the two IS educators involved for assessment purpose. This is a common approach for manual grading. Three other IS assessors were contacted independently to assess students' contributions for both IS courses. All the assessors have more than six years teaching experience of IS courses. The assessors felt comfortable reviewing the discussion. The IS assessors who participated in the evaluation were considered as a representative sample of IS educators who might potentially use forum software for PBL in IS education. The forum software was available for the IS assessors (a total of five assessors) to view the learning context even though the student discussion was over. The projects' title and description were sent to the three assessors as well.

The authors set the coefficients (c, d, e, f, g, h, j, k, m, n, p) of SCAFFOLD to 1, a = 1 and b = 0.001. The same coefficients were set for the two IS courses throughout the evaluation. This is because the IS assessors grading preferences were unknown. However, when the grading preferences are known, it is easy to adjust the coefficients to reflect the grading preferences. The Pearson product-moment correlations between the PI and the actual grades were calculated. Correlations between individual measures (except for timeliness) and the actual grades were also calculated as shown in Table 1 for W1 and Table 2 for W2. The results in the second column of Table 1 and Table 2 demonstrate that there is a high correlation between the PI and the actual grades (0.827 - 0.996). The results in each row of Table 1 and Table 2 demonstrate the correlation between the PI and the actual grades given by different IS assessors. According to a report in the essay grading literature, agreement between computer graders and human judges varies from 0.4 to 0.9 approximately, and that is comparable to or even better than agreement between two human graders. The results also show that, in most cases, PI performs slightly better than any of the three measures, that are total message count, total message length and SCAFFOLD.

Table 1 Correlations for IS course W1

| | R (PI- G) | R(TM- G) | R(TL- G) | R(S-G) | | | | |
|------------|--------------|-------------|-------------|--------|--|--|--|--|
| | - / | - / | - / | | | | | |
| Assessor 1 | 0.988 | 0.979 | 0.887 | 0.980 | | | | |
| Assessor 2 | 0.852 | 0.806 | 0.905 | 0.857 | | | | |
| Assessor 3 | 0.936 | 0.928 | 0.758 | 0.935 | | | | |
| Assessor 4 | 0.885 | 0.900 | 0.797 | 0.863 | | | | |

Table 2 Correlations for IS course W2

| | R (PI- | R(TM- | R(TL- | R(S-G) |
|------------|--------|-------|-------|--------|
| | G) | G) | G) | |
| Assessor 1 | 0.996 | 0.993 | 0.853 | 0.991 |
| Assessor 2 | 0.930 | 0.923 | 0.905 | 0.926 |
| Assessor 3 | 0.942 | 0.937 | 0.835 | 0.939 |
| Assessor 4 | 0.827 | 0.789 | 0.901 | 0.848 |

R(PI-G): correlation between the PI and the actual grades

R(TM-G): correlation between the total message count (TM) score and the actual grades

R(TL-G): correlation between the total message

length and the actual grades

R(S-G): correlation between the SCAFFOLD and the actual grade

6. Limitations

During the evaluation period, the network in UNI X was not reliable towards the end of evaluation. This has caused redundant data (message) appear in the forum and data lost. The forum software evaluated the redundant data more than once.

The evaluation only focused on two final year degree-level discussion forum in IS courses and five IS assessors were involved. It would not be prudent to over generalize the evaluation results.

7. Conclusion

In the evaluation of the accuracy of the assessment model, the authors found that the PI score generated from the model were highly correlated with the actual grades assigned by the IS assessors. The difference between the judgments of different IS assessors grading the same class independently is also low. It is reasonable to assume that such correlation is comparable to what has been reported in the automatic essay grading literature [15]. Thus, the evaluation results suggest that the performance of the assessment model is comparable to, if not better than, that of a human instructor. Therefore, the computer generated PI can be implemented as a teaching tool to help IS educators obtain a reference to students' performance without reading through the huge amount of class messages, which is a tedious and

intensive procedure. The tool could be employed as a supplementary grader to help IS educators make better judgments with reduced workload.

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