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Evaluation of an On-Line Reflective Journal in Engineering Education

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ABSTRACT: Reflective thinking based on experiential learning is a key skill for the professional engineer. The use of a reflective learning journal is thought to be a valuable tool in developing ‘reflexivity’. An evaluation was undertaken of student perceptions of an on-line reflective journal introduced into an engineering management study unit.

Keywords: engineering education; reflective journal; on-line assessment

INTRODUCTION

In 2003, for the first time, students in a fourth-year engineering management study unit were asked to complete an on-line reflective journal as an assessable task. To measure student
perceptions of this new assessment task, it was decided to undertake a formal evaluation.
This paper reports on the importance of reflective journals and critical reflection on action, the
introduction of an on-line reflective journal for students, and the results of the evaluation of
student perceptions of the on-line reflective journal.

REFLECTION AND REFLECTIVE JOURNALS

In the context of learning, reflection refers to the active intellectual monitoring and evaluation
of one’s own formal learning and professional practice activities, to examine them for new
understandings to add to the individual’s accumulated knowledge and experience. Reflective
thinking based on experiential learning is a key skill required for the lifelong learner and the
socially mature professional [1, 2]. As members of one of the design professions, many
engineers regularly encounter new and unique problem situations, and the process of
designing solutions for these problems provides a fertile ground for experiential learning and
reflection on action. Effective use of reflection is an important element of the on-going
professional development of engineers. The use of a reflective learning journal (due to the
requirement to transfer thought processes into words) is thought to be a valuable tool in
developing ‘reflexivity’ [3], particularly for students [4]. For the practicing professional, the
use of a work journal offers additional benefits – it may be an admissible legal document in
the case of a dispute about the conduct of work, and it may be a valuable record of the
conduct of project work [5]. The use of a reflective journal in the undergraduate preparation
of engineering students is an opportunity to develop a familiarity with work journals and
reflective practice.
There is evidence of the value of reflective journals in engineering education contexts in the literature. In a composite materials class a reflective journal was used for students to describe a real application of a section of theory presented in class. It was suggested that, “These [journals] give the students the opportunity to make use of the theoretical knowledge they meet in each section of the course by reflecting on how it is applicable to a real application. The goal is for better, more integrated understanding…” [6]. In another trial of reflective journal writing, it was found that, “…when students voluntarily write reflective journal entry essays on assigned reading, their performance on multiple-choice quizzes on the reading is improved compared to students who did not complete such essays.” [7]

It is recognized that reflection is not only an individual activity, but may contain social/learner-learner aspects as well [8]. It is reported that collaborative reflective activity and the ability to compare ones own thinking with that of other learners yields positive results and better facilitated learning than individual reflection [9]. It was identified in the composite materials class case above that an important future enhancement of the use of reflective journals would be the incorporation of a social dimension to allow individual students to contribute to the development of a collective understanding [6].

The development of computer conferencing and computer managed communication (CMC) systems have provided a wide array of on-line communication and collaboration tools, including on-line journals [10]. There are examples in the literature of the use of the Internet for on-line journals [11], including online reflective journals [12].

AN ON-LINE REFLECTIVE JOURNAL IN ENGINEERING EDUCATION

The School of Engineering and Technology at Deakin University in Australia offers a three year Bachelor of Technology (B Tech) and a four year Bachelor of Engineering (BE) at
undergraduate level. The programs are delivered on-campus, off-campus and off-shore in Singapore and Malaysia (through twinning partner institutions). The author has academic responsibility for the fourth-year engineering management study unit SEB421 Strategic Issues in Engineering. This unit consists of three modules:

1. Technological Forecasting and Assessment;
2. Policy Design in Engineering Organizations; and
3. Issues in Productivity Improvement.

The Technological Forecasting and Assessment module discusses methods for long-term forecasting, factors in technological innovations, and the impact of technological changes on business and society. The topics in the Policy Design in Engineering Organizations module are policy structure, designing organizational structure to support policy, and modeling and analysis of policy alternatives. The Issues in Productivity Improvement module focuses on labor and management productivity, productivity improvement techniques, benchmarking and the changing nature of work practices. The author has previously employed a paper-based individual reflective journal as an assessment activity in this study unit [13].

Prior to 2003, each student was required to keep an individual hardcopy reflective journal. The purpose and value of critical reflection as one of the main avenues for the self-development and consolidation of knowledge based on the experience of the practicing professional was explained to the students. At the completion of the weekly class, students were asked to respond in writing in their journal to the following two questions, “What did I learn today?” (reflection), and, “How will this be of use to me in the future?” (critical reflection). As long as the response was thoughtful and considered, students received one percent of their final grade for each week that they completed a journal entry, up to a maximum of 10 percent. This class also contained off-campus students who completed their
journal across the semester at their home location, and submitted their completed written journal at the end of the semester.

Deakin University uses the WebCT Vista on-line course management system (CMS). In 2003, students in SEB421 were asked to make their weekly journal entry in an on-line discussion area. The discussion area is essentially an asynchronous bulletin board to which all class members have read and write access. A separate discussion area was created for each nominal class week to provide some structure and direction to students, and to break the large number of student postings into manageable sections. The same assignment questions and marking criteria as previously used for the hardcopy journal were employed for the on-line journal. In addition to on-campus and off-campus Australian students, beginning in 2003, the class also contained a significant number (approximately 30 percent of the enrolment) of students studying in Malaysia. The on-line nature of the system meant that all students could post their journal entries weekly, regardless of their study location or mode of study. Because the journal entries were posted to a discussion area with open read access to all class members, all journal postings were potentially available to all students to read. While there was no formal requirement for students to read and/or respond to the journal entries of other students, in recognition of the potential enhancement of reflexivity arising from the social aspects of reflection, students were encouraged to view the journal postings of their class peers. In addition to the formally assessed weekly journal discussion areas, there was a single general SEB421 discussion area open for students to make postings and to ask questions on any topic. To assess student perceptions of this new development in the application of an on-line reflective journal, it was decided to undertake a formal evaluation in 2003.
METHOD

The evaluation took the form of a written questionnaire. At the end of the semester the questionnaire was distributed to on-campus students in class, and was mailed to all enrolled off-campus students. Off-campus students were provided with a ‘reply-paid’ envelope, so their completed questionnaire could be returned at no cost to the student. As required by the Deakin University Human Research Ethics Committee, participation in the survey was anonymous and voluntary. The questionnaire sought responses under the following categories:

- demographic information – age; gender; course of study; location of study;
- reflective journal – did you understand its purpose?; rate its value;
- use of journal – frequency of access; did you read submissions of other students?;
- on-line system – rate the system’s ease of use;
- general – what aspects of the on-line reflective journal were most useful?; least useful?

RESULTS AND DISCUSSION

Demographic Information

43 valid questionnaire responses were obtained from a total class enrolment at the time of the questionnaire of 83 students, giving a response rate of 51.8 percent. The following respondent age statistics were collected from the questionnaire: mean age 26.1 years; standard deviation 7.7 years; age range 19 to 47 years; and median age 22 years. The following respondent gender statistics were collected: female 9.3 percent; and male 90.7 percent. The
following respondent course of study statistics were collected: Bachelor of Engineering 88.4 percent; Bachelor of Technology 7.0 percent; and Other (international exchange students and students enrolled in a single unit only) 4.6 percent. The following respondent study location statistics were collected: on-campus 55.8 percent; off-campus 30.2 percent; Singapore 0.0 percent; and Malaysia 14.0 percent.

The gender, course of study and study location characteristics of the entire class group where known, permitting a comparison of the population and respondent sample groups. The proportion of females in the population was 8.4 percent, which was not significantly different from the respondent group ($\chi^2_1 = 0.027, p > 0.869$). The proportion of BE students in the population was 95.2 percent, the proportion of BTech students in the population was 2.4 percent and the proportion of Other students in the population was 2.4 percent, which was not significantly different from the respondent group ($\chi^2_2 = 2.079, p > 0.353$). The proportion of on-campus students in the population was 41.0 percent, the proportion of off-campus students in the population was 38.9 percent, the proportion of Singaporean students in the population was 1.2 percent and the proportion of Malaysian students in the population was 28.9 percent, which was not significantly different from the respondent group ($\chi^2_3 = 4.555, p > 0.207$). The good match between the demographic characteristics of the respondent sample and population groups suggests that valid conclusions about the population group can be inferred from the respondent group.

**Value of Reflective Journal**

Respondents were asked to indicate (Yes or No) whether they felt that they clearly understood the purpose of the reflective journal in SEB421. 92.9 percent of respondents indicated ‘Yes’, and 7.1 percent of respondents indicated ‘No’. There was no significant correlation between
this response and any respondent demographic group. These results suggest that additional explanation of the purpose of the reflective journal would be of benefit to a small percentage of the students in this unit.

Respondents were asked to rate, on a scale of 1 to 5 (1 = not valuable at all, 5 = extremely valuable), the value of the reflective journal in their learning in SEB421. The mean response was 3.6 (with a standard deviation of 0.87) and the median response was 4. There was no significant correlation between this response and any respondent demographic group. These results indicate that the reflective journal was considered valuable by a majority of students in the unit.

Use of Reflective Journal

Respondents were asked to indicate which of the following statements most accurately described the frequency of their accessing the reflective journal discussion area – ‘Daily’; ‘2-6 times per week’; ‘Weekly’; or ‘Less than weekly’. The responses received were ‘Daily’ – 2.3 percent; ‘2-6 times per week’ – 14.0 percent; ‘Weekly’ – 51.2 percent; and ‘Less than weekly’ – 32.6 percent. These results indicate that a majority of students did not access the on-line journal more than weekly. This outcome is likely to be related to the unit assessment requirement for journal entries to nominally be made on a weekly basis.

Respondents were asked to indicate (Yes or No) whether they read the reflective journal entries of other students. 97.7 percent of respondents indicated ‘Yes’, and 2.3 percent of respondents indicated ‘No’. For those respondents who answered ‘Yes’ to having read the reflective journal submissions of other students, they were asked to indicate (Yes or No)
whether reading the journal submissions of other students assisted their learning in SEB421. 76.2 percent of respondents indicated ‘Yes’, and 23.8 percent of respondents indicated ‘No’. These results indicate that a majority of students derived some benefit from reading the journal entries of other students. A correlation was observed between these responses and the ratings given by respondents to the value of the reflective journal in their learning in SEB421. The two respondent groups (‘Yes’/’No’) were independent, had an approximately Gaussian distribution and had approximately the same variance, permitting a two-sample t test of mean ratings. Under this test the mean value of the reflective journal in their learning was significantly different between the two respondent groups ($t_{12} = 3.288, p < 0.007$); those respondents who indicated that reading the journal submissions of other students assisted their learning confirmed this particular educational value that they were deriving from the on-line journal by also giving a significantly higher rating to the value of the reflective journal in their learning (‘Yes’ mean rating = 3.84; ‘No’ mean rating = 2.80).

**General**

Respondents were asked to rate, on a scale of 1 to 5 (1 = very difficult, 5 = extremely easy), the ease of use of the Vista CMS for making their on-line journal submissions. The mean response was 3.8 (with a standard deviation of 1.12) and the median response was 4. These results indicate that the Vista CMS was generally considered easy to use for the task of completing on-line journal entries.

Respondents were asked to rate, on a scale of 1 to 5 (1 = not valuable at all, 5 = extremely valuable), the value of the general SEB421 discussion area. The mean response was 3.2 (with a standard deviation of 0.85) and the median response was 3. These results indicate that the
perceived value of the general SEB421 discussion area was lower than the on-line reflective journal. This may be related to the fact that completion of the on-line journal was an assessable task, and hence given a higher priority by students, while participation in the general discussion area was at the discretion of the student.

A correlation was observed between the reported value of the general SEB421 discussion area and the ratings given by respondents to the value of the reflective journal in their learning in SEB421 \( (r = +0.381) \). The response pairs had an approximately Gaussian distribution, permitting a parametric test that the correlation coefficient was equal to zero. Under this test it was found that the correlation coefficient was significant \( (p < 0.007) \). Additionally, a correlation was observed between the reported value of the general SEB421 discussion area and whether reading the journal submissions of other students assisted their learning in SEB421. The two respondent groups (‘Yes’/‘No’) were independent, had an approximately Gaussian distribution and had approximately the same variance, permitting a two-sample \( t \) test of mean ratings. Under this test the mean value of the general SEB421 discussion area was significantly different between the two respondent groups \( (t_{13} = 3.440, p < 0.004) \); those respondents who indicated that reading the journal submissions of other students assisted their learning gave a significantly higher rating to the value of the general SEB421 discussion area (‘Yes’ mean rating = 3.42; ‘No’ mean rating = 2.40). These two correlations suggest that students who found value in one on-line element of the unit (the reflective journal) may have been positively predisposed to other on-line elements of the unit.

Respondents were given the opportunity to give an open-ended written response to the question, ‘What aspects of the on-line reflective journal did you find most useful?’
provides the categorized responses to this question and the frequency with which they were reported.

[Table 1 about here]

The most frequent response related to the compulsion to review the course material for the purpose of responding to the weekly journal question, “What did I learn today?” This indicates that many students have found it valuable to engage in reflection on their studies, but this does not necessarily mean that they have actively engaged in critical reflection on their learning, which was an important intention of the reflective journal, and which was mentioned explicitly in responses by only four students. It is noted that the second most frequent response related to the ability of students to compare their own reflective thinking with that of other students. This is an encouraging response, as the use of a public on-line discussion area was purposefully employed to permit the possibility of enhanced reflexivity arising from the social aspects of reflection noted on the literature [8]. It is reported that collaborative reflective activity and the ability to compare ones own thinking with that of other learners yields positive results and better facilitated learning than individual reflection [9]. As noted above, those students who indicated that reading the journal submissions of other students assisted their learning also gave a significantly higher rating to the value of the reflective journal in their learning.

Respondents were given the opportunity to give an open-ended written response to the question, ‘What aspects of the on-line reflective journal did you find least useful?’ Table 2 provides the categorized responses to this question and the frequency with which they were reported.
The most frequent responses relate not to the actual journaling activity, but rather to problems associated with the use of the CMS for the completion/submission of journal entries. This suggests that if students perceive the CMS user interface to be deficient, this will reflect negatively on their experience of the underlying educational activity that is mediated by the CMS. The critical affect of the user interface on the user’s perception of computer-based systems, irrespective of the actual purpose of the system, is documented in the literature [14].

CONCLUSION

An evaluation was undertaken of student perceptions of an on-line reflective journal introduced for the first time in a fourth-year engineering management study unit. Questionnaire responses indicated that:

- a majority of students understood the purpose of the journal, and valued the journal in their learning;
- a majority of the students did not access the journal more than once per week;
- a majority of students read the journal entries of other students, and indicated that this assisted their learning;
- the two most frequently reported ‘most useful’ aspects of the on-line journal were the ‘enforced’ continuous revision of course material, and the ability to compare their understanding of the course material with that of other students; and
• the two most frequently reported ‘least useful’ aspects of the on-line journal were related to problems associated with the use of the CMS.

While a majority of students indicated that they understood the purpose of the reflective journal, and the students’ journal entries did show evidence of critical reflection on their learning; in terms of the most useful aspects of the journal reported by students, the opportunity to critically reflect on learning was ranked much lower than the opportunity to revise (that is, merely reflect on) their weekly study. For the small number of students who reported that they did not have a clear understanding of the purpose of the reflective journal, and to help all students to differentiate between reflection and critical reflection (both of which were desired in this exercise), in the future it is planned to enhance the explanation of the purpose of the on-line reflective journal.

Evidence was observed of the social aspect of reflective learning – most students reported reading the journal submissions of other students, and the ability to compare ones thoughts with others was frequently reported by students as the most useful aspect of the on-line journal. There are opportunities to enhance this social aspect of the reflective journal by formalizing it as part of the assessment process; perhaps requiring students to read and comment on the submissions of other students, and/or requiring students to develop more substantial journal submissions in small groups.

A critical influence on the students’ perception of the on-line journal was the usability of the CMS. Even though the CMS was generally rated by students as easy to use, it was most frequently reported as the least useful aspect of the on-line journal.
Table 1 - Most useful aspect of on-line reflective journal

<table>
<thead>
<tr>
<th>Most useful aspect of on-line reflective journal</th>
<th>Frequency of reporting</th>
</tr>
</thead>
<tbody>
<tr>
<td>Continuous revision of study materials</td>
<td>16</td>
</tr>
<tr>
<td>Ability to compare my own thoughts with others</td>
<td>8</td>
</tr>
<tr>
<td>Electronic submission of entries was convenient</td>
<td>6</td>
</tr>
<tr>
<td>Chance to critically evaluate the study materials</td>
<td>4</td>
</tr>
<tr>
<td>Weekly entries helped to pace my study</td>
<td>1</td>
</tr>
</tbody>
</table>
Table 2 - Least useful aspect of on-line reflective journal

<table>
<thead>
<tr>
<th>Least useful aspect of on-line reflective journal</th>
<th>Frequency of reporting</th>
</tr>
</thead>
<tbody>
<tr>
<td>CMS user interface difficult to use</td>
<td>7</td>
</tr>
<tr>
<td>Problems with CMS operation</td>
<td>2</td>
</tr>
<tr>
<td>Having to think critically</td>
<td>1</td>
</tr>
<tr>
<td>CMS operation slow</td>
<td>1</td>
</tr>
<tr>
<td>No immediate feedback on weekly entries</td>
<td>1</td>
</tr>
</tbody>
</table>
REFERENCES


