

Online self and critical reflective journal approach: a collaborative learning in Engineering design

Dean Cvetkovic^a and Jaideep Chandran^b
School of Electrical and Computer Engineering, RMIT University^a
School of Engineering, Deakin University^b
Email: dean.cvetkovic@rmit.edu.au

Structured abstract

BACKGROUND

The general purpose of timely self and critical reflective journal activities is for students to gain a deeper understanding of professional practice knowledge in a collaborative learning environment. Online and paper-based reflective journal exercises are well known to engineering education community. However, there is lack of literature in the evaluation and implementation of strategic reflective journal methods, aimed at bridging student personal experiences with the non-technical teaching content presented in classrooms and engineering team projects.

PURPOSE

The aim of this study was to evaluate implemented strategic reflective journal approach in order to improve student learning outcomes and cooperative learning.

DESIGN/METHOD

An approach was applied to simultaneously implement and evaluate RMIT University's Engineering Design courses offered at year 3 undergraduate and postgraduate levels. This approach consisted of timely online self and critical reflection innovation; several study methods and three main hypotheses with multiple control and experimental groups. Students were required to write timely reflection self or critical journal entries in online Blackboard environment, whilst paper-based surveys were administered at 5 time-points in order to collect and analyse data.

RESULTS

The outcomes from the statistical analyses revealed that the quality of self and critical reflection entries improved because of student practice in learning how to writing these reflection entries. It assisted students to pay more attention in the classroom and in learning better when they were able to view their team member's explanations. However, students did not think reflection activity provided them with sufficient feedback on their learning which was initially expected.

CONCLUSIONS

This study revealed that applied strategic reflective journal approach, improved team development and certain learning outcomes in engineering design curriculum.

KEYWORDS

Collaborative learning, Engineering design, online self and critical reflective journal

Introduction

The general purpose of timely self and critical reflective journal activities is for students to gain a deeper understanding of professional practice knowledge in a collaborative learning environment. Reflection is a critical activity which helps reinforce the student's sense of accomplishment (Dunlap 2005). A study was conducted to evaluate the student perception on the online reflective journal assessment, undertaken by the fourth-year engineering management students (Palmer et al 2008). Palmer's study also explored the value of reflective journaling in engineering education and the contribution of the reflective journal to learning outcomes. The findings from this study revealed that the reflection activity on learning they applied improves student learning outcomes. The most evident benefit of this reflective journal activity was that it encouraged students to continuously revise their learning material and thus have a positive contribution on student final assessment, as well as being able to compare own thoughts when reading the posts of other students. Other findings showed no correlation between reading posts and final marks. However, Palmer and colleagues did highlight that online reflection activity does bring an important element to educational technology. Further discussion was based on student perception and contribution to learning outcomes.

The online and paper-based reflective journal exercises are well known to engineering education community. However, there is lack of literature in the evaluation and implementation of strategic reflective journal methods, aimed at bridging student personal experiences with the non-technical teaching content presented in classrooms and engineering team projects. This paper presents a recent study conducted at School of Electrical and Computer Engineering (RMIT University, Melbourne, Australia) to evaluate its third year undergraduate Engineering Design 3A/3B (EEET2258/2259) courses in terms of the impact of online reflective journals approach on student's collaborative learning (i.e. working in teams) and learning outcomes. The course consists of structured and well-defined *team* project based or collaborative learning supplemented by the cross-disciplinary lectures and project teachings. One of the main objectives of this course is to improve student professional practice learning outcomes and enhance the student design skills of working on industry and research related projects, making a student more employable, entrepreneurial, productive and innovative once they graduate.

The purpose of this reflective journal exercises were for students to gain a deeper understanding of the lectures and to track their own insights into their learning process and performance. This knowledge and experience would eventually lead toward helping individuals improve their actions and professional engineering practice. Whilst reflection can be seen as a natural and familiar process allowing us to analyse and summarise our experiences (Daudelin 1996), for our study it was recommended that students avoid summarising the lecture or write it in the form of a diary. The course manual and guideline was created to assist students on how and what to include in their reflection.

Students were expected to describe the learning context. For example: what students know already, what have students observed, to explore, contemplate and analyse experiences within their team or another team, how have students improved in their learning, how students interpret the meanings, feel and make choices to form action from the learning situations presented during the lecture. *Students were instructed that these timely reflection entries needed to create a 'bridge' between their personal experiences, their learning gained from the lectures and their student team project, product, design or developing process.* In a way, students are encouraged to try to answer their own question of how could a particular lecture, based on either non-technical or technical content, assist them to improve their product or project.

Methodology

A research study was conducted and the aim of this study was to evaluate implemented strategic reflective journal approach in order to improve student learning outcomes and cooperative learning.

Approach

In the lecture part of this course in Semester 1, students were presented with a non-technical (non-engineering) topics ranging from team dynamics, business oriented topics such as Project management and finance; Leadership; Conflict management in teams; Intellectual property and patenting; workshops on effective presentation and report writing skills, etc. These topics cover specialised knowledge tools that a professional engineer should be equipped with. Similar to Semester 1 lectures, Semester 2 lectures were a mixture of some engineering based and non-technical type topics. The lectures typically were 2 hours per week, 12 and 6 weeks in Semester 1 and 2, respectively.

Self and critical reflection pairing process

Every two weeks students were required to write one online reflection entry, based on any of the two lectures during the two weeks. Students simply had to choose one of the two topics and write a single reflection entry. It was recommended to write no more than 400 words in a single fortnightly entry. This particular lecture assessment was aimed at creating an interactive environment through the process of student communication, experience, reflection and analysis. Student members in their teams were interacting with one another in their respected teams. While some members in their teams were writing their self reflection entry, they were paired with the other team members (within their team), who needed to write a critical reflection based on their team member's self reflection entry. This reflection activity was conducted every two weeks and the pairing of self and critical reflectors was rotated every two weeks. For example, the pairing for self and critical reflectors for the first 4 weeks is described in Table 1. Similar pairing schedule was continued for the remaining weeks throughout both semesters. If a team member did not provide their self reflection as agreed, the critical reflector would only provide their self-reflection instead. It was important that there was a good communication between the paired reflectors.

Table 1. An example of self and critical reflector pairing for the first 4 weeks only.

| Journal entry submission deadlines | Pairing of self and critical reflectors |
|---|---|
| Journal entry no.1: Fri 15 Mar, 5pm (W2) | John (self) – Julia (critical) David (self) – Rahul (critical) Sam (self) – Matt (critical) |
| Journal entry no.2: Wed 27 Mar, 5pm (W4) | Matt (self) - John (critical) Julia (self) - David (critical) Rahul (self) - Sam (critical) |
| | |

Self and critical reflection assessment

In terms of assessment in semester 1, 10% weighting was allocated for self-reflection and 10% weighting for critical-reflection. This was a 20% weighting in total throughout the semester 1. Considering that in semester 2, the number of lectures were reduced by a half, 5% weighting was allocated for self-reflection and 5% for critical-reflection. These self and critical reflections were assessed using the assessment criteria described in Table 2 and 3.

Table 2. Self-Reflection Assessment Criteria.

| | |
|--------------------------------------|--|
| Not demonstrated (0) | made no attempt to provide a self-reflection entry |
| Minimally demonstrated (1-2) | made minor attempt to provide a brief summary of the lecture |
| Demonstrated (3-4) | summarised the lecture readings like a diary and briefly relating the lecture topic with their team project |
| Met requirements appropriately (5-7) | described one or two personal experiences and attempted to relate the lecture topic with their team project |
| Exceptional (8-10) | described two or more personal experiences, justified personal thoughts, attempted to creatively relate the lecture topic with their team project and identified the future action |

Table 3. Critical-Reflection Assessment Criteria.

| | |
|--------------------------------------|---|
| Not demonstrated (0) | made no attempt to provide a critical or self-reflection entry |
| Minimally demonstrated (1-2) | made minor attempt to provide a brief summary of the lecture with no feedback to team member's self-reflection and without relating the lecture topic with their team project |
| Demonstrated (3-4) | summarised the lecture readings like a diary, made minor attempt to provide feedback to team member's self-reflection and briefly attempted to relate the lecture topic with their team project |
| Met requirements appropriately (5-7) | described one or two personal experiences by providing feedback and attempted to relate the lecture topic with their team project |
| Exceptional (8-10) | constructively engaged with self-reflector's experiences by providing feedback, describing two or more own personal experiences, creatively relating the lecture topic with their team project and identified the future action |

Study protocol and participants

The whole study protocol consisted of teaching activities assigned to multiple Control and Experimental groups. The paper-based surveys were administered at 5 time-points and data was collected and analysed for both semester 1 and 2. Each survey had 60+ Likert-type and open-ended questions which were statistically analysed using various quantitative techniques (with hypotheses testing). RMIT University Ethics committee approved the study and 32 participants signed the consent letters, administered throughout 5 time points during the data collection. The student enrolment number was 210.

Semester 1 Self and critical reflector study design

In Semester 1, the self-reflectors had to provide an online (in Blackboard team Blogs) self-reflection entry and their self-rating while the critical reflectors had to provide their critical

reflections and also peer-to-peer assess (i.e. rate their paired self-reflectors on their entry). The whole reflection entry, pairing and assessment process was set-up in each of the team Blogs and accessed by 2 teams at any time. This enabled team members to view and edit their own team Blog and their paired team Blog, but not other teams. Individual students in their teams were specifically paired with individuals from another team while the whole process was rotated in that pairing arrangement on the weekly basis. Every week students were required to make an online (Blackboard's team Blogs) reflection entry based on the non-technical lecture presented in that week. Members in their teams were required to either adopt self or critical reflector roles, depending on the week's schedule. For example, in semester 1 (weeks 2 to 6), one would provide a self-reflection entry, besides their critical reflector providing them with feedback, the critical reflector was required to rate their reflection entry (out of 10). The critical reflections were assessed by the investigator while the ratings and pairing combination of members and teams was undertaken using Excel spreadsheet that was updated in team Blogs. The rating entries in this spreadsheet were *transparent* to all team members and their paired team. In semester 1 (week 7 to 12), this assessment changed slightly and the critical reflector was not required to rate their paired self-reflector as it was assessed by the investigator. There was no self-ratings of own self or critical reflection entries required. The semester 1 reflection activity only had an Experimental (1) group which included combined SET 1 and 2 teams. The experimental design involved two SETs of teams ('SET 1' – team numbers 1-19, and 'SET 2' – team numbers 20-38). The Control (1) group did not exist in semester 1. Refer to Table 4 for study design for semester 1.

Semester 2 Self and critical reflector study design

From Semester 2 (week 2 to 6), team members were required to rate their own self or critical reflection entries. This rating was conducted using individual and peer-blind submission of reflection own self or critical ratings using 'Google doc' tool. Whilst in semester 1, any timely peer-to-peer ratings were transparent to own and paired team members, in semester 2 the Google doc technology enabled to conduct a peer-blind rating process. Another study feature which differed between the two semesters was that in semester 2 the self and critical pairing was conducted entirely within own teams, closing the link for their paired team to access their team Blog. During semester 2 week 1-3, SET 1 teams were assigned to Control (2) group and SET 2 teams to Experimental (2) group. During week 4-6, these SET 1 and 2 teams swapped their groups – SET 1 was Experimental (2) and SET 2 Control (2). Refer to Table 4 for study design for semester 2. A series of two different timely and carefully orchestrated instructions, were sent to each of SET groups via Blackboard emailing system. These email instructions were sent to two SET groups on specific dates and times and consisted of hyperlinks to Google doc surveys, which were created prior to being announced in these emails.

For example, in Semester 2 week 1-3, students in SET 1 group, being the Control (2) group, were required to provide their individual weekly *self* reflection entry in their team Blog and rate it (out of 10) in their Google doc form. In this form, students also needed to identify themselves by entering their password code, team and member numbers so that data can be tagged with their other activities. These individual self reflection entries did not require any critical reflection feedback. It was assessed by the instructor (assessor) at the end of semester 2. Only one assessor was marking all reflections in this study, thus the marks were not affected by different instructors. The SET 2 group in week 1-3 was part of Experimental (2) group. These individuals were required to decide with whom they would pair within their own team and organise weekly self and critical reflector roles which needed to be rotated every week. Like SET 1 teams in week 1-3, the SET 2 self reflectors were required to provide their individual weekly *self* reflection entry in their team Blog and rate it (out of 10) in their Google doc form. But the critical reflectors within the same team were required to provide a critical reflection in their team Blog as a feedback to their paired self reflector's entry but also provide their own reflection on that week's lecture. These critical reflectors were also required to rate (out of 10) their own critical reflection entry. In addition to this

rating which needed to be entered in their Google doc form, students also needed to identify themselves by entering their password code, team and member numbers and select whether they were the self or critical reflectors in that week, as part of tagging and identification of data with their other activities. During week 4-6, these SET 1 and 2 teams swapped their groups, as shown in Table 4. All members of every team were assessed by the instructor, irrespectively if they were self or critical reflectors, or Control (2) or Experimental (2), SET 1 or SET 2 groups.

Table 4. Reflection activity study design for semester 1 and 2.

| Semester 1 & 2, 2011 | | Reflections & Team SET No. | Method |
|----------------------|-----------|--|---|
| Semester 1 | Week 1-6 | Reflections – Experimental (1) | Face-to-face or online, transparent rating & Peer-to-peer assessment |
| | Week 7-12 | Combined SETs | Face-to-face or online & transparent rating |
| Semester 2 | Week 3 | Reflections – Control (2) (SET 1) & Experimental (2) (SET 2) | Peer-blind and online self rating |
| | Week 4-6 | Reflections – Control (2) (SET 2) & Experimental (2) (SET 1) | |

Results

There was no hypothesis designed to test the individual semester 1 reflection data because there was no Control (1) group, just Experimental (1) with some minor method (refer to Methodology section) variations between week 1-6 and week 7-12.

Xie and colleagues discussed the strategies of using peer feedback on reflective journals to promote reflection as well as deep thinking and learning (Xie et al 2008). Our following Hypothesis #1 explored this effect in the use of self-reflection journals and critical reflection journals from their peers.

Hypothesis #1: *The timely self and critical reflections method Experimental (2) in semester 2 improved the quality of reflection entries and cooperative learning than Control (2) in semester 2.*

We initially compared the statistical difference for staff rating between SET 1 and SET 2 in weeks 1-3 & weeks 4-6 of semester 2. Two independent samples *t*-test was conducted to examine the difference between staff rating between the two SETs at weeks 1-3 and weeks 3-6. Results indicated a significant difference between the SETs at both time points, $t(64) = -2.694, p = 0.009$ for week 1-3; and $t(97) = -2.866, p = 0.005$ for week 4-6. Specifically, SET 2 always had a higher staff rating compared to SET 1 for week 1-3 and week 4-6 points (refer to Table 5). For both SETs, week 4-6 staff ratings were substantially higher 49.40 SET1 and 67.25 SET 2 than week 1-3, 43.69 SET1 and 63.01 SET2, respectively. While Experimental (2) SET 2 group in week 1-3 had a substantially higher staff rating of 63.01 than Control (2) SET 1 group of 43.69, the **hypothesis #1 was partly supported**. However, in week 4-7, the Experimental (2) SET 1 group had a substantially lower staff rating of 49.40 than Control (2) SET 2 of 67.25, and therefore **partly not supporting hypothesis #1**. In addition to our results, it can be revealed that the quality of self and critical reflection entries improved not necessarily because of our method which encourages feedback and peer-critique, but

because of the *progression and practice in writing these reflection entries*. The results from our study match the findings presented by Xie and colleagues (Xie et al 2008).

Table 5. The comparison between SET 1 and 2 semester 2 reflection staff ratings.

| | SET 1 | | SET 2 | |
|---------------|----------|-----------|----------|-----------|
| Staff ratings | <i>M</i> | <i>SD</i> | <i>M</i> | <i>SD</i> |
| Weeks 1 - 3 | 43.69 | 32.29 | 63.01 | 25.22 |
| Weeks 4 - 6 | 49.40 | 33.47 | 67.25 | 28.05 |

In order to determine the degree of assessment difference between the assessor (staff) and student rating them-selves, another similar statistical difference comparison was conducted between SET 1 and SET 2 in week 1-3 and week 4-6. A paired samples *t*-test was conducted to examine the difference between staff ratings and self ratings between SETS 1 and 2. There was a significant difference between the two ratings, $t(32) = -6.281, p = 0.01$ for week 1-3; and $t(39) = -3.848, p = 0.01$ for week 4-6, with students from both SETs giving themselves a significantly higher self rating compared to the staff rating (refer to Table 6). This finding just prove that there is a perception of what students think is a deserved rating of their entries and what is actually rated by the assessor (staff). However, SET 1 self ratings were substantially lower than SET 2 in week 1-3 and SET 1 self ratings were substantially higher than SET 2 in week 4-6. This shows that our self and critical reflection method, through Experimental (2) group, does not contribute towards addressing this student's perception by lowering their self ratings to staff rating level. Xie and colleagues commented that the moderation by staff and its effect on the quality of the reflections, the use of effective moderation and constructive feedback allowed the students to produce more effective and collaborative development in their reflection journals (Xie et al 2008).

Hypothesis #2: *The timely self and critical reflections technique Experimental (2) in semester 2 improved the quality (higher staff ratings) of reflection entries and cooperative learning than Experimental (1) group in semester 1 week 6-12.*

A paired *t* test was conducted to examine the difference between staff ratings between semester 1 and semester 2 for each of the SET groups. Results indicated that there was a significant difference between staff ratings for the semesters, $t(79) = -3.482, p = 0.01$ for SET 1; and $t(79) = -8.206, p = 0.01$ for SET 2. Specifically, it was worth noting that the staff ratings in semester 2 were significantly higher than the staff ratings for semester 1 for both SETS (refer to Table 7). With these findings, **this hypothesis #2 is supported.**

Table 6. The comparison between SET 1 and 2 semester 2 reflection staff and self ratings.

| | | SET 1 | | SET 2 | |
|-------------|---------------|----------|-----------|----------|-----------|
| | | <i>M</i> | <i>SD</i> | <i>M</i> | <i>SD</i> |
| Weeks 1 - 3 | Staff ratings | 43.69 | 32.29 | 63.01 | 25.22 |
| | Self ratings | 82.00 | 12.07 | 86.50 | 13.09 |
| Weeks 4 - 6 | Staff ratings | 49.40 | 33.47 | 67.25 | 28.05 |
| | Self ratings | 86.25 | 14.08 | 84.48 | 12.98 |

Table 7. The comparison between SET 1 and 2 semester 1 and 2 reflection staff ratings.

| | SET 1 | | SET 2 | |
|---------------|----------|-----------|----------|-----------|
| Staff ratings | <i>M</i> | <i>SD</i> | <i>M</i> | <i>SD</i> |

| | | | | |
|------------|-------|-------|-------|-------|
| Semester 1 | 38.72 | 26.78 | 32.28 | 27.57 |
| Semester 2 | 52.45 | 32.09 | 63.71 | 29.31 |

Hypothesis #3: *The peer-to-peer rating (critical reflectors rating self reflectors) as self and critical reflections method Experimental (1) in semester 1 week 1-5 is not an accurate assessment when compared to Experimental (1) in semester 1 week 6-12 and Experimental (2) and Control (2) in semester 2.*

The definition of reflection is purposeful thinking oriented towards a goal and during the process of analysing and examining ones experiences we are involved in deep thinking which promotes learning (Dewey 1993 and Moon 1999). A good critical reflector promotes reflective thinking by broadening the quality of the reflection and providing a different perspective thereby helping the learning process (Xie et al 2008). Xie and colleagues and Yang also contend the critical reflections provided by the peers do not always promote the reflective thinking (Xie et al 2008 and Yang 2009) - Hypothesis #3 was set to evaluate this process.

Independent samples *t* test were conducted to examine the difference between the Experimental and Control groups staff ratings across the two semesters. Specifically, we were interested in comparing semester 1, weeks 1-5 with the other 3 time points. Results indicated that there was a significant difference between the time points in semester 1 ($t(52.24) = 2.915, p = 0.033$ for SET 1; and $t(78.01) = 5.071, p = 0.01$ for SET 2) and semester 2 ($t(64) = -2.694, p = 0.009$ for SET 1; and $t(97) = -2.86, p = 0.005$ for SET 2). Table 8 shows the descriptive statistics for staff ratings across the time points. It appears that semester 1 week 1-5 ratings were higher than they should be (refer to Table 8). This is due to critical reflectors being allowed to act as staff 'raters' as part of peer-to-peer assessment. However, there is a progressive improvement in the quality of reflection entries from second part of semester 1 to end of second part of semester 2, again showing that practice improves the quality and not necessarily the self/critical reflection method applied in this study.

Table 8. The comparison between SET 1 and 2 weekly Semester 1 and 2 reflection staff ratings.

| Staff ratings | | SET 1 | | SET 2 | |
|---------------|--------------|--------------|--------------|--------------|--------------|
| | | <i>M</i> | <i>SD</i> | <i>M</i> | <i>SD</i> |
| Semester 1 | Weeks 1 - 5 | <u>50.51</u> | <u>46.12</u> | <u>63.82</u> | <u>40.08</u> |
| | Weeks 6 - 12 | 32.90 | 29.93 | 34.45 | 26.64 |
| Semester 2 | Weeks 1 - 3 | 43.69 | 32.90 | 49.40 | 33.47 |
| | Weeks 4 - 6 | 63.01 | 25.22 | 67.25 | 28.05 |

Hypothesis #4: *From the Survey conducted at five time points, from 'prior semester 1' to 'semester 2 week 7-13', students (individually and as a team) exhibited improvement in each of the learning items listed under Q34-48.*

The Kolb model of experiential learning consisted of reflective observations, allowing students to develop self-reflective capabilities (Graeff 1997 and Hey et al 2007). Hey and colleagues further mentioned that the reflective practice was the process of thoughtfully considering one's own experiences in applying knowledge to practice and this process promotes learning and the lessons learned through self reflection provide the students with insight into their own experiences (Hey et. al 2007). Kavanagh and colleague's findings showed that the reflection helps in improving the professional competencies of the students (Kavanagh et al 2008). McBrien and colleagues also mentioned that the reflection on one's practice provides an insight into personal understanding and control (McBrien et al 2006). Whereas, Palmer reported that the students indicated the journals assisted them in their learning and it enforced revision of the course material and helped them compare their

understanding of the course material with peers (Palmer 2004). Hypothesis #4 therefore aimed to evaluate the self and critical reflection journal used in our course in these categories.

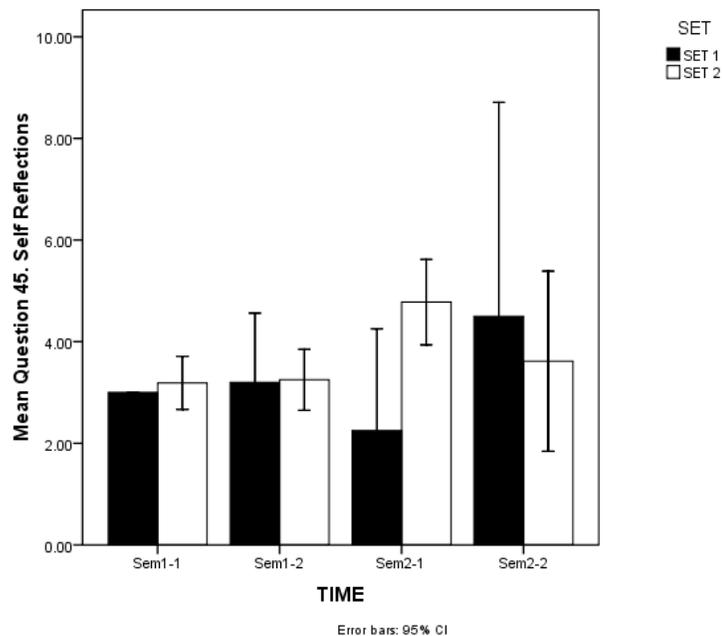
Chi-Square tests were conducted for each item to see if there was a significant association between responses and time point. The results revealed no significant association for both SETs. Cross-tabulations were provided for Q34–Q43 (refer to Table 9). When the standardised residual is greater or lower than +2.0/-2.0, this represents a group that was overrepresented/underrepresented to what was expected of the data. Once again, the question related to ‘attention’ (having had to write my own self or critical reflection made me pay more attention to the lecture topic being presented as compared to my other courses) has revealed the most positive response ‘strongly agree’ at the end of semester 2, but in SET 1 group, as compared to SET 2 activity. ‘Feedback’ (receiving a critique about my self or critical reflection, helped me learn) question returned both ‘disagree’ with 3 counts and ‘strongly agree’ with 1 count, at middle and end of semester 2, respectively. This showed both negative and positive responses to ‘feedback’ with higher inclination towards negative, meaning that self and critical reflection activity does not assist students with feedback. However, this reflection activity certainly assisted well when ‘explanation’ (seeing my peers self and critical reflection explanations, helped me learn) is concerned – both ‘agree’ and ‘strongly agree’ at middle and end of semester 2, respectively. ‘Misunderstanding’ (discussing reflections with my peers addressed my misunderstanding about the lecture’s topic) revealed ‘disagree’ and ‘agree’ with 3 counts each, at middle and end of semester 2, respectively. But because of ‘disagree’ higher std. residual (2.9), it is considered more negative. ‘Fairness’ (my rating of self and peer reflections is *fair*) revealed ‘strongly disagree’ at middle of semester 2. Because there was no peer-to-peer rating or assessment (not like first half of semester 1), this rating would only be directed and related to instructor/assessor’s assessment of participant’s reflection deliverable. This explains the reason why self-ratings were generally higher than staff ratings, showed in Table 8. All of the above survey responses were found to be by SET 1 group during semester 2. Perhaps, this was because SET 1 was Experimental (2) group in week 4-6 (final reflection activity period) and its lecture topics ‘resonated’ more with students – lecture in week 5 was most challenging and week 6 the easiest. Interestingly, ‘my experience and connection’, related to ‘*deeper*’ learning through reflection writing, ‘interaction and discussion’, ‘interaction with technology’, ‘my rating of self and peer reflections’ and ‘sharing’ was not overrepresented by cross-tabulation.

Table 9. Summary of cross-tabulations provided for Q35–Q43 (reflection activity).

| Q # | question | SET 1 | | | SET 2 | | |
|-----|--------------------|-------|--------------------------|-----|-------|----------------------------|-------|
| | | s.r. | rating | SEM | s.r. | rating | SEM |
| 35 | attention | 2.1 | Strongly Agree | 2-2 | 2.0 | Neither Agree nor Disagree | prior |
| 36 | feedback | 2.2 | Disagree (3 counts) | 2-1 | | | |
| | | 2.4 | Strongly Agree (1 count) | 2-2 | | | |
| 37 | explanation | 1.9 | Agree | 2-1 | | | |
| | | 2.1 | Strongly Agree | 2-2 | | | |
| 40 | misunderstanding | 2.9 | Disagree (3 counts) | 2-1 | | | |
| | | 1.9 | Agree (3 counts) | 2-2 | | | |
| 43 | fairness | 2.4 | Strongly Disagree | 2-1 | | | |

Note: **Q35-43 rating scale:** (1) Strongly Disagree; (2) Disagree; (3) Neither Agree nor Disagree; (4) Agree; (5) Strongly Agree.

In analysing the responses Q45 (refer to Fig. 1a)), 'How many self reflection entries have you submitted?', one-way ANOVA was conducted to examine if there was a difference between time points for the number of self reflection entries students had submitted. No significant difference was discovered, $F = 1.613$, $p = 0.231$ SET 1 and $F = 1.955$, $p = 0.133$ SET 2 ($F = 1.05$, $p = 0.38$). By observing Fig. 1 a), SET 1 number of self reflection entries decreased and SET 2 increased by the middle of semester 2. This is interesting since the survey responses were overrepresented in SET 1 group. The end of semester data can be ignored since there was no reflection activity conducted in the second part of semester 2, there could have been some confusion which explains the large 95% CI for both SET 1 and SET 2 bars. In analysing the responses Q46 (refer to Fig. 1 b)), 'How many critical reflection entries have you submitted?', another one-way ANOVA was conducted to examine if there was a difference between time points for the number of critical reflections students had submitted. A significant difference was discovered for SET 2 only, $F = 1.116$, $p = 0.376$ SET 1 and $F = 3.790$, $p = 0.016$ SET 2 ($F = 5.12$, $p < 0.01$), with the more critical reflections being submitted in semester 1 than semester 2 and slightly more in second part of semester 2 and first despite the fact that there were was no reflection activity in later part of semester 2 – again large 95% CI shows the large discrepancy.



a

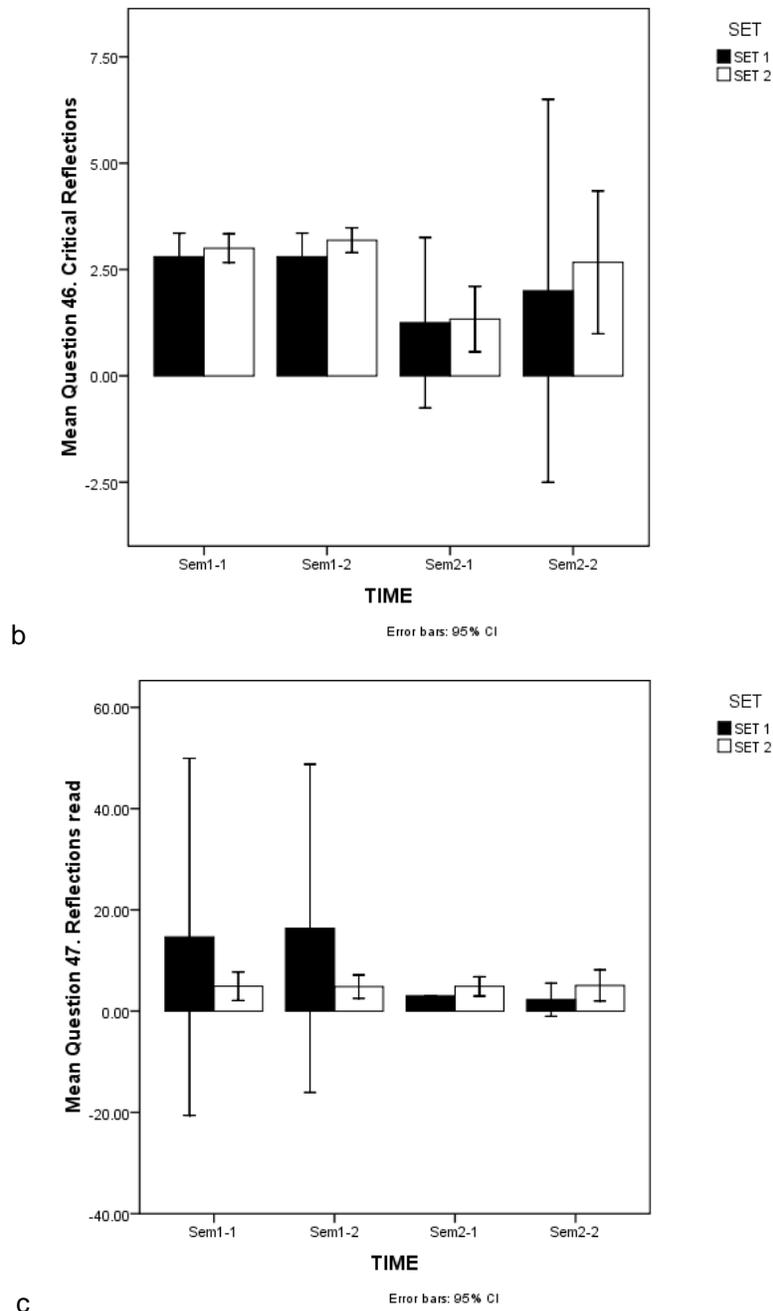


Figure 1. The frequency of self (a) and critical (b) reflection entries submitted and read (c).

For Q47 (refer to Fig. 1 c)), ‘How many other members’ self and critical reflection entries have you read?’ another one-way ANOVA was conducted to examine if there was a difference between time points for the number of reflections students had read. No significant difference was discovered, $F = 1.806, p = 0.224$ SET 1 and $F = 0.007, p = 0.999$ SET 2 ($F = 0.76, p = 0.52$). However, there seemed to be more (with larger than normal 95% CI) SET 1 students to have read other reflection entries (17-18) than SET 2 (5) in semester 1, while that comparison reversed significantly in semester 2 where SET 2 remained consistent in their reading while SET 1 decreased to 2-3 reads. This explains that SET 1 in semester made fewer entries, they needed to read other’s entries, which also explains their overrepresented survey responses. It may have seemed that this SET 1 group benefited (learning) the most with this reflection activity.

Conclusion

This study was designed to evaluate three (3) major teaching activities employed within the Engineering Design 3 courses, timely reflection, feedback and peer assessment teaching methodologies, in order to improve student *learning outcomes* and *cooperative learning*.

The conducted Reflection activity revealed that the quality of self and critical reflection entries improved not necessarily because of the effective methodology which encourages feedback and peer-critique, but because of student progression and practice in learning how to writing these reflection entries. In relation to self and assessor (instructor) rating of their reflection entries, there seemed to be student perception of what students thought was their deserved rating, as to what was actually rated by the assessor. The conducted self and critical reflection method, did not contribute towards addressing this student's perception by lowering their self ratings to staff rating level. One group of teams claimed to have read more other member's reflection entries throughout semester 1, while this reading rate decreased significantly throughout semester 2. This perhaps explains that this group made fewer reflection entries because they were not quite sure how to do it and they needed to read other member's entries, which also explains their overrepresented survey responses. It seems that this group benefited to learn the most with this reflection activity. The reflection activity helped students pay more 'attention' to the lecture topic being presented and certainly assisted them in learning when they were able to continuously see their peers' self and critical reflection 'explanations'. Students did not think reflection activity provided them with sufficient 'feedback' on their learning. However, one would think that 'feedback' leads to 'explanation'.

References

- Dewey, J. (1933). *How we think*. Boston, MA: D.C. Heath and Co.
- Dunlap, J. C. (2005). Problem-based learning and self-efficacy: How a capstone course prepares students for a profession. *Educational Technology Research and Development*, 53(1), 65-83.
- Graeff, T. R. (1997) Bringing reflective learning to the marketing research course: A cooperative learning project using intergroup critique, *Journal of Marketing Education*, 19(1), 53-64.
- Hey, J., Van Pelt, A., Agogino, A., & Beckman, S. (2007) Self-reflection: lessons learned in a new product development class, *Journal of Mechanical Design*, 129(7), 668-676.
- Kavanagh, L., & O'Moore, L. (2008) Reflecting on reflection—10 years, engineering, and UQ. In *19th Annual Conference of the Australasian Association for Engineering Education: To Industry and Beyond*, Institution of Engineers, Australia.
- McBrien, B. (2007) Learning from practice—reflections on a critical incident, *Accident and Emergency Nursing*, 15(3), 128-133.
- Moon, J. A. (1999). *Reflection in learning and professional development: Theory and practice*. London Sterling, VA: Kogan Page: Stylus Pub.
- Palmer, S. (2004) Evaluation of an online reflective journal in engineering education. *Computer Applications in Engineering Education*, 12(4), 209-214.
- Palmer, S., Holt, D., & Bray, S. (2008) The Online Outcomes of an Online Reflective Journal in Engineering, *Proceedings ASCILITE 2008*, Melbourne, pp. 724-732.
- Wood Daudelin, M. (1997) Learning from experience through reflection. *Organizational Dynamics*, 24(3), 36-48.
- Xie, Y., Ke, F., & Sharma, P. (2008) The effect of peer feedback for blogging on college students' reflective learning processes. *The Internet and Higher Education*, 11(1), 18-25.
- Yang, S. H. (2009) Using blogs to enhance critical reflection and community of practice, *Educational Technology and Society*, 12(2), 11-21.

Acknowledgements

This project was funded by RMIT University Scheme for Teaching and Learning Research (STeLR) grant in 2012. We also acknowledge RMIT's Sports Statistics team for the statistical analysis in this project.

Copyright statement

Copyright © 2013 Cvetkovic and Chandran: The authors assign to AAEE and educational non-profit institutions a non-exclusive licence to use this document for personal use and in courses of instruction provided that the article is used in full and this copyright statement is reproduced. The authors also grant a non-exclusive licence to AAEE to publish this document in full on the World Wide Web (prime sites and mirrors), on Memory Sticks, and in printed form within the AAEE 2013 conference proceedings. Any other usage is prohibited without the express permission of the authors.