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Structured Reflection Facilitates Metacognitive Awareness and Learning

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Advancing Active Learning

Structured Reflection Facilitates Metacognitive Awareness and Learning

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Abstract

Many students in Higher Education (HE) struggle with the concept of reflective practice, hence they do not engage well with the process and its full value is seldom realised. Using a simple software system developed to facilitate and structure the recording, storage and retrieval of reflections, students were able to monitor their development, resulting in improved metacognition. Students reported feeling empowered and perceived their learning had been enhanced since using the system.

Background

Reflective practice is acknowledged as a process for personal and professional development (e.g., Dewey, 1933/1993; Kolb, 1970; Schön, 1983; 1987; Boud, Keogh & Walker 1985; Eraut, 1994; Moon, 1999). Effective reflective practitioners work through problems by means of considering and reevaluating past experience in light of their current position and knowledge (e.g. Dewey, 1939b; Boud, 2001). This process leads to formulations of new insights (Boud, Keogh & Walker, 1985), and promotes self-monitoring and personal development (Dewey, 1939b; Dunning, Johnson, Ehrlinger & Kruger 2003). These are key components of metacognition (Flavell, 1979), a predictor of successful learning, academic performance (e.g. Coutinho, 2007) and even intelligence (e.g. Sternberg, 1984; 1986a; 1986b). Despite a lack of consensus on the definition of metacognition, its emphasis is consistently on the role of executive processes in overseeing and regulating cognitive processes (Livingston, 1997). Metacognition is maximized when practiced over a period of time (meta-reflection; Dewey, 1939b). Thus learning comes through a cyclical process of reflection, evaluation, decision, action and reflection (Schön, 1983).

Reflective learning is essential for lifelong learning, and students in Higher Education (HE) are increasingly required to develop personally and professionally by reflecting critically on their learning as part of their coursework. Philip (2006) emphasizes the difficulties of teaching and encouraging reflective practice, as she suggests it is a process with which students and some staff are uncomfortable. Furthermore, perhaps in part due to membership of the 'net generation' (McNeely, 2005), many students do not engage in the reflective process since it does not align with their preferred learning style (Grant, Kinnersley, Metcalf, Pill & Houston, 2006). In addition, the current assessment-driven paradigm in HE results in reflections being assessed alongside other course work. This is potentially problematic (Boud, 1999; Sumsion & Fleet, 1996) as evidence suggests that when reflections are read, graded or assessed by others, the incentive is to demonstrate knowledge and hide ignorance or doubt (Boud & Walker 1998). This

is counter to Dewey's (1939b) original purpose of reflection in which learning is derived from making mistakes and solving problems.

Early research (e.g. Johnson & Walton, 1975) found greater honesty and disclosure in computer-mediated communication compared to written or face to face responses. However, more recently, evidence has been inconclusive in this regard. Nevertheless, information and communication technology (ICT) can afford advantages over pen and paper approaches. These include accessibility, synchronous and asynchronous communication, a 'safe space' for interactions and personal thoughts, and importantly, anytime, anyplace learning (Barak 2006; Paulus & Roberts 2006). Furthermore, ICT facilitates reflective thinking (Lin, Hmelo, Kinzer & Secules, 1999; Barak, 2006), and as it is an inherent part of the 'net generation' (McNeely, 2005), it appeals to this population's learning style (Grant et al., 2006). However, without appropriate structure, ICT used for reflective practice, retains the same nebulous aspect characteristic of traditional reflective approaches (logs and journals) in which the potential for maximizing metacognition and learning is not achieved. Structure has been found to enhance metacognition, thus learning. For example, when Alevan and Koedinger (2002) investigated the use of 'intelligent' instructional software, a 'Cognitive Tutor', to guide participants in problem solving tasks by means of structuring (scaffolding), they found enhanced metacognition and greater success on transfer problems.

In sum, reflective practice is an acknowledged tool for professional and personal development. However, students and some staff are uncomfortable with reflecting. Furthermore, agreement on what constitutes reflective practice is elusive and instruction on becoming an effective reflective practitioner is sparse. Moreover, the focus is frequently on improving the reflective writing style rather than learning about learning (metacognition). Writing reflections is time consuming and novices can be put off by the nebulous nature of the traditional approach which does not appeal to their learning style. The assessment-driven curriculum leads to the assessment of students' reflections. This can result in each assessed reflection being perceived as a stand-alone piece of work rather than a stage in development that should be reflected on in future. Even more damaging, assessment can lead to a lack of disclosure of areas for improvement; the basic components of the reflective cycle.

In order to challenge traditional approaches and overcome the associated obstacles, a small scale study was undertaken at Southampton Solent University (SSU) in 2009. The study's main aims were (i) to encourage students to engage in reflective practice using ICT in a novel, online, scaffolded approach, and (ii) to encourage students to become efficient and effective reflective practitioners. Moreover, rather than focusing on developing writing skills, the focus was explicitly on developing learning skills (i.e. metacognition, Flavell, 1979).

Method

As stated previously, students and some staff in HE struggle with reflecting. In addition to apprehension about reflective practice, many students tend not to understand the purpose or the benefits. Thus, the aims of this study were to simplify and demystify the process, and to encourage participants to reflect regularly and effectively to result in enhanced metacognition and increased learning. To this end, a simple spreadsheet was developed using Microsoft Excel. It was designed to structure the reflection process and guide participants in recording reflections

by means of prompts (column headings). Additionally, to further appeal to the sample drawn from the net-generation, the spreadsheet was available on the University's Virtual learning Environment (VLE). Furthermore, given the inherent problems associated with assessment of reflective practice, recorded reflections were not assessed and were anonymous. This moved the emphasis from proficiency as a reflective *writer* to proficiency as a reflective *learner*.

Meta-reflection occurs when past reflections are reviewed and reevaluated in the light of new situations and experiences. However, locating and retrieving past reflections recorded using traditional approaches can be problematic, time-consuming and frustrating. Perhaps because of this, past reflections are often recalled from memory which renders them vulnerable to the problems associated with human memory such as bias, suggestibility, embellishment and forgetting (Schacter, 1997). Online recording of reflections affords a permanent record which can be retrieved easily. The structured nature of the spreadsheet further facilitates retrieval of a specific experience as reflections can be sorted by key words.

The rationale for using a spreadsheet was that cell headings could be designed to guide the reflection process to maintain focus on learning. As reflections are recorded, each row is completed. As reflections are added (weekly or more frequently), information down the columns is also built up. Each row would lead logically through problem identification, strategy, through solution to consideration of what had been learned; each column would show development over time. This would facilitate metacognition and ultimately learning, to develop by means of guidance through the reflective process cycle. In this sense, participants would monitor their development and gain a deeper understanding of their learning process. Please see Figure 1 for an illustrative example of a spreadsheet completed over a period time.

Participants

Ten first year Psychology undergraduates (9 females, 1 male) at SSU volunteered to take part in the study. Participants received course credit for their time.

Materials

A 14-item semi-structured questionnaire was administered prior to the focus group. An Excel spreadsheet was made available to the participants on the University's VLE throughout the study. Semi-structured individual interviews were administered at the end of the study.

Procedure

The study took place at SSU over a 12-week period from January to March 2009. Prior to commencement, ethical approval was given by the Psychology Department's Ethics Committee. Participants were given the study instructions, a consent form and semi-structured questionnaire to read and complete before taking part in a one-hour focus group. Items from the questionnaire were used to generate discussion at the focus group, which was audio-recorded. Participants were assured that their reflections would be anonymous, confidential, and not assessed. They were also instructed that the focus of their reflections should be on understanding their learning. Following the focus group, participants practiced how to access, download, edit and upload the Excel spreadsheet from the VLE. Participants were instructed to reflect at least weekly. In accordance with the British Educational Research Association (BERA) ethical guidelines, no student should be disadvantaged. To address this, a crossover design was employed. Participants were randomly allocated to one of two groups, A and B. Group A was instructed to record in

weeks 1 to 6; group B to record in weeks 6-12. In this sense, participants acted as their own control. After the data collection period, individual semi-structured interviews were held with four volunteer participants.

Week	Date	Topic	Feelings	Hurdles to get over	Strategies	How did I break the task down?	Was that useful? Yes/No	Why?	What have I achieved?	How do I feel?	What have I learned?
1	05/01/2008	presentation	scared about the idea of talking in front of English people not in my first language	feeling confident during the speech	continuous practice	working alone and in group	yes	for a better organization of the whole assignment	a good and easy performance	more confident about my future presentations	how to develop an argument chosen by us in working group
2	12/01/2008	1 Tests in SPSS	initially confused because I missed the first seminar and the second lecture	understand related test (within design)	borrow from the library Cooligan's book	I wanted to buy Cooligan's book but it wasn't anymore available so I had to borrow it	yes, a lot	to complete portfolio number 5 of PMS	the capability of completing portfolio 5	well organized with the preparation of my assessments	how to have a good understanding of a topic even without being to the lecture
3	19/01/2008	summary of journal article	a confident because of the useful guide provided by the tutor	develop my work respecting the right structure	read many times the article	confused about how put the references	yes	to start my assignment for abnormal psych	an ability in identifying what has to be included because important	I have to check few things with my teacher	how to summarize
4	26/01/2008	essay outline for social psychology	preoccupied about the opinion of the reviewer they were harder than that of the first period	considering the most reliable sources as answer the topic respecting precisely what the question was	consult the guide provided to us	I wasn't completely sure about my structure (bullet points one)	medium	to finally develop my work	a positive feedback even if I didn't completely agree with the reviewer	better than after my first essay outline (developmental psych)	an easier and probably more comprehensible outline
5	02/02/2009	reflections for integrating psychology2	not too happy about it as I have been ill for 5 weeks not but feel bad for my group who have seen me sparingly	Just doing what I can and turning up. I know the material just need to be confident	read carefully all the material available on my course	I had missed a lecture and I was scared about not being able to complete what was asked to me	yes, a lot	now I have all my 3 reflective journals made	I have the portfolio complete	satisfied	how to organize a paragraph in the best way possible
6	09/02/2009	presentation	not too happy about it as I have been ill for 5 weeks not but feel bad for my group who have seen me sparingly	Just doing what I can and turning up. I know the material just need to be confident	look at the guidelines my group made up for me in terms of the powerpoint outline for the presentation	I was given the discussion section of the report so I just used my past report as a guide and the information from the class results	No, actually	no one ended up doing the presentation but I felt good I had done some prep as we still have the psychical report to hand in	I have been able to communicate with my group who really helped me out on this report this time round		'Work hard when you can in your group and keep in contact with at least one person so they know what is happening and don't panic if you don't contact them
7	16/02/2009	research methods tests for experiments	decided not to get left behind and had to think of a way to make me learn this topic well	Mentally tackling one test at a time as I have learnt them and working with a friend	Using q cards to write down the tests and criteria on other side	wrote down what components identified each test	Yes and we tested each other in turn	There were 9 cards each for each test and we were able to break down our learning in order to memorise the data	I have learnt the test for today but know, however it is in short term memory	Great as it didn't take that long to do and just a couple of hours to get into our heads, we actually call it the research game	I early 'left' it until tomorrow but a report is due and in contact with at least one person so they know what I can do in the day that I have time. Too many things often crop up the next day but once you start something and follow it through, you enjoy the process and enjoy more the accomplishment. I feel like I have done something. There are things you can do to save yourself unnecessary stress
8	23/02/2009	research methods portfolio	not wanting to leave everything until the last minute and be stressed	organising my folder first so I know where I am and get rid of scraps of paper	do it in chronological order	The coursework is in the same pattern as the learning schedule so can be followed in that order	yes, as with last week	Each test for the portfolio is taken in turn and having the portfolio review week helps get the work done	Getting into a pattern for being more organised but still recognise large scope for improvement	Good although almost need more time initially to be this organised. The result after accomplishing something is a good	
9	02/03/2009	speed reading	read slowly I think compared to most people	'worried that I would not be able to retain the information	Grouping three words together and practicing reading a couple of passages before and after	The first passage before grouping three words together was timed and the second was timed to show up any improvement	yes, it did not actually feel like it but there was	It was a special paper my boyfriend had obtained in one of his lectures and two passages had a word count on it. I had 2 minutes to read each of the passages and was about 10-15%.	Killing two birds with one stone by reading an article for its substance and writing a summary	I am so happy about this as I can break down an article even if I don't fully understand it	There are several techniques that I have heard of but have not used as yet and I am glad I took the opportunity to use this one as I can practice daily. It takes a lot more concentration though as I do tend to wonder off from reading some pieces of info eg newspaper articles, journal articles.
10	09/03/2009	reading articles	difficult to do and large chunks or reading of putting and don't know if I will understand article	Trying to avoid wondering off when I am reading and concentrating harder and making trying to find the outline to work for the busy week	Reading paragraph by paragraph and looking at the title and referring back to it to make sense of article	Break the title down and look at the layout of the first paragraph and look for the main points whilst asking questions	yes, I have never looked at it this way before and it is a very useful tool	I have used this style of bullet points which work well for me due to the style of planning I like to use and find effective.	I am not satisfied with my work but surprisingly I received the best peer review for the outline	I have learned that the way a friend learns who is foreign is also a useful technique to how I can learn. I picked up these skills from student support	
11	16/03/2009	cognitive essay	really busy week and none of these outlines have helped for essay planning	using the essay outline guide, knowing what I need to include and how to layout the outline	full intro and full conclusion and decided to use bullet points for the body of the outline	yes but it was not enough as I did not do enough background	yes but I knew it was going to be beforehand	I can avoid reading the whole article too many times as I have just the relevant information without the fluff	Picking out the information that makes sense and moves the main point of the article to a conclusion	I am grateful for learning this task but also feel this has been the most useful and adaptable skill so far	I learnt that I have achieved my goal of being organised and the outlines have helped me achieve that
12	23/03/2009	article summary	not seeing the point of this exercise - would be more enthusiastic if I knew why	I have a mental reading block and need to force myself before I can relax into it	breaking the article down into paragraphs using the skill I learnt two weeks ago and making own notes	highlighters and notes with post-it pads on article highlighting main points	yes but I knew it was going to be beforehand	I can avoid reading the whole article too many times as I have just the relevant information without the fluff	Picking out the information that makes sense and moves the main point of the article to a conclusion	I am grateful for learning this task but also feel this has been the most useful and adaptable skill so far	I have observed how my colleagues learn who have English as a second language and have also found their techniques useful

Figure 1 Example of reflections recorded on the spreadsheet over a period time

In summary, the semi-structured questionnaire, focus group and individual semi-structured interviews were used to elicit a rich and deep understanding of reflective practice, to generate a discussion of reflective practice and to evaluate the effectiveness of the resource respectively. The focus group and interviews were audio-recorded, transcribed and checked for inter-rater reliability. The transcriptions and responses to the semi-structured questionnaire have been described in Mair (2010, submitted). Reflections uploaded to individual spreadsheets are discussed in this paper.

Results

Participants ($n=10$) were instructed to reflect on coursework and general study skills. Nine topics and nine themes were recorded (Figures 2 and 3 respectively). Each participant recorded reflections for 6 weeks. Entries were categorised into nine themes using inter-rater reliability.

Contributions from participants ranged from 9 to 59 (mean 36.5). Unsurprisingly, out of a total of 365 themed entries, 125 (34%) were in the category ‘Feelings’, fewest (5) were ‘Revising’ (1%). Please see Appendix A for raw data. Most participants (8) entered recordings for 5 or 6 weeks. However, participant 1 recorded during week one only. Participant 3 recorded only for 3 weeks; only one of these entries was complete (i.e. taken to the final prompt ‘what have I learned?’). Furthermore, these two participants did not volunteer to be interviewed at the end of the study.

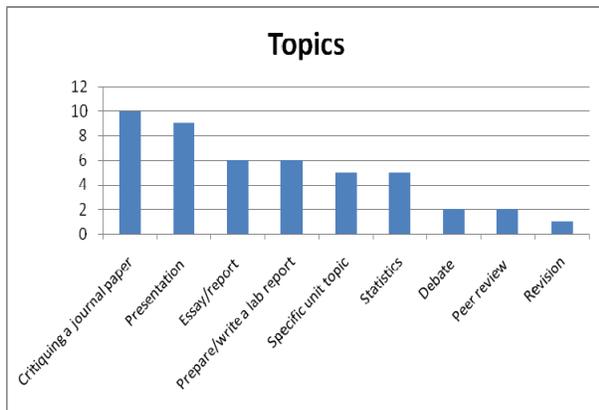


Figure 2 Topics

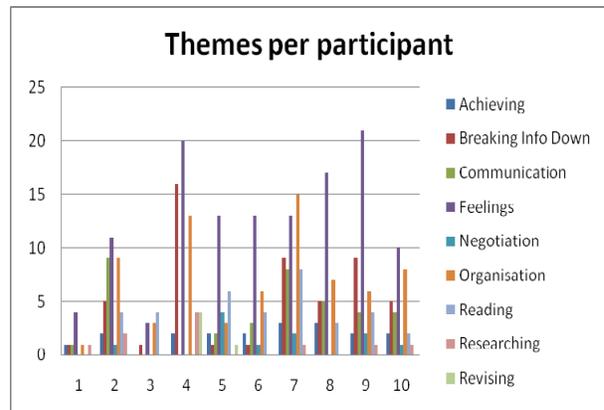


Figure 3 Themes per participant

Focusing on the final spreadsheet column headed ‘What have I learned?’ Participants’ entries included:

- *‘It isn’t REALLY overly scary to give a presentation.’ (P1)*
- *‘That when I start a task I know that I enjoy it and then I feel good about getting work done. That I can actually enjoy a piece of work and not have to cram it all into one day! Even what I may find a boring task at the start, may not be boring when I start it’ (P4)*
- *‘Once you start something and follow it through, you enjoy the process and enjoy more the accomplishment. I feel like I have done something today. There are things you can do to save yourself unnecessary stress.’ (P7)*
- *‘Not to be afraid of asking for help and not to worry about speaking in class’ (P8)*
- *‘That I can do things when I try hard and don’t worry about them too much.’ (P10)*

In terms of improving metacognitive awareness and learning, participants commented:

- *‘I learned how to work with others of various strengths and weaknesses. You can’t rely on others. Things can change – it is how we adapt to the change that makes a difference. There is always someone who can help or who knows someone who could help.’ (P2)*
- *‘I can use flow charts as a revision aid. So if I set out a time slot for my work and then work towards a goal I am more likely to get the work done than if I didn’t have a structure. I work well under a structure. I know how to plan things. Breaking down a task makes it easier to complete. Taking breaks keeps your brain more focused!’ (P4)*

- *'If you break down work into sections it's much easier to have control over it. Reading can reinforce [consolidate] your knowledge as you recognise what your lecturer has already discussed. I am able to allow a student [peer] to mark my work and I have gained the confidence to mark somebody else's.'* (P6)
- *'Work hard when you can in your group and keep in contact with at least one person so they know what is happening. I have learned to try to do what I can when I have time. The way a foreign friend learns is also a useful technique for me. I have achieved my goal of being organized using structure and outlines.'* (P7)
- *'Not to leave things so late. Always make use of the drop in sessions for all units. It's better not to rush straight into my work.'* (P8)
- *'Remain calm. Don't sit back and wait. Practice makes things better. Take your time and keep on trying.'* (P9)
- *'I can do things when I try hard and don't worry too much about them.'* (P10)

In addition to the results described here, results from the pre-intervention questionnaire, focus group and post-intervention interviews are described in Mair (2010, submitted). It is useful to mention here that during the pre-intervention focus group the researcher asked participants to define reflective practice. The reply was that reflective practice is *'a recap on what was learned.'*

Selected abstracts from individual post-intervention interviews, conducted to evaluate the experience of using the spreadsheet, afford deeper discussion of the results in this paper:

- *'...was more focused on learning and helps with stress management*
- *made me look at my work as a problem which needed to be resolved*
- *allowed me to sort it out in my own mind and reflect on my experiences rather than a prescribed topic*
- *gave me time to reflect in a particular week... the next week, I'd look at what I'd put the week before*
- *was actually quite enjoyable*
- *is really nice to actually think about how I've improved and assess myself*
- *focused me on learning and made me evaluate everything*
- *makes you assess yourself*
- *helps you gain self-confidence by realising you have the ability and strengths and you can accomplish what you set out to do*
- *I found it really useful and always filled in the spreadsheet...I always found it was easier to complete my reflective journals [for coursework] after I had done this [the study].'*

The 'scaffolded' structure was commended by participants for maintaining focus:

'it focused me more than [journals]; gave me more focus and more relevance; helped focus what I was writing about; if I just had one open-ended question I wouldn't have reached a conclusion about what I learned.' Comments also referred to its therapeutic nature: *'it helped me put down my thoughts and feelings, it was just like having a counselor; it was quite cathartic; it allowed me to see how thoughts develop...and importantly, its role in learning, 'it's a learning experience.'*

'It's hard getting my thoughts down on a blank canvas. I like visual things so I did find it really helpful having those boxes, and every box helped lead me onto the next one. It flowed really well. Each box directed me think about how I dealt with that issue.'

Discussion

The main aim of this paper is to describe the rationale, method and outcomes of a small-scale study conducted at SSU in 2009. In the study, participants were encouraged to become efficient and effective reflective practitioners. The focus was maintained on developing learning skills, i.e. metacognition (Flavell, 1979), to lead to a greater understanding of the executive processes that regulate cognitive processes (Livingston, 1997) and enhance academic performance (e.g. Schön, 1983; Dunning, et al., 2003; Coutinho, 2007).

Reflective practice (e.g. Schön, 1983) helps develop experiential learning (Moon, 1999; Boud, et al., 1985). However, the lack of agreement on the nature of reflecting (Eraut, 1995) can lead to poor instruction and assessment practice. As a result, reflective writing is frequently a process of responding to predetermined questions, and is assessed as a stand-alone piece of work. Assessment may lead to a lack of disclosure of weaknesses (Boud & Walker 1998; Boud, 1999; 2001) which reduces the effectiveness of reflective practice (Sumsion & Fleet 1996), and is counter to Dewey's (1939b) original premise. These inherent problems may in part be responsible for the discomfort with reflecting felt by many students and some staff (Philip, 2006).

Metacognition is a corollary of reflective practice. However, there is also a lack of agreement on the definition of metacognition. Therefore, to encourage reflective practice with a focus on enhancing metacognition and learning, the researcher explicitly informed participants about metacognitive awareness, the nature of reflective practice, the rationale for the study. Participants were encouraged to disclose in confidence when reflecting, knowing that their reflections would remain anonymous and not be assessed.

ICT appeals to the net generation's (McNeely, 2005) learning style (Grant et al., 2006) and can facilitate reflective thinking, enhance metacognition and learning. Furthermore, when used in conjunction with scaffolding, ICT enhances metacognition (Lin et al., 1999; Barak, 2006; Alevan & Koedinger, 2002). To this end, a Microsoft Excel spreadsheet, incorporating prompts for guidance was designed to simplify and structure the recording, storage and retrieval of reflections. The spreadsheet was situated on the VLE and the focus was explicitly on learning about *learning*, as opposed to learning about *content*.

A clear lack of understanding of reflective practice was evident from the pre-intervention questionnaire and focus group (reported in Mair, 2010, submitted). Worryingly, reflection was defined as recapping on what had been learned rather than how it had been learned. In fact, reflection was perceived as revision. However, reflections recorded on the spreadsheet suggest participants had focused on learning about learning, not learning about content possibly as a result of the structuring for guidance. Reflections described how participants had overcome problems and derived a sense of achievement in a range of academic areas, such as learning to work with others, understanding the value of adaptability and of using structure for planning and

organization. These findings and those from the post-intervention interviews provide evidence for the effectiveness of the spreadsheet as a tool for encouraging continued reflective writing that enhances metacognition and ultimately learning.

Limitations

Although the results suggest the study aims have been met, there are several limitations. Firstly, the small sample size inhibits generalization. However, the qualitative methodology allows deep insights into the data from this small sample. The limited data collection period reduces the opportunity for proficiency to develop. Unfortunately, the 6-week period was necessary in order to employ a crossover design and to complete the project on time. A larger sample, incorporating a separate control group rather than the present crossover design, and a longer data collection period would start to address these shortcomings. However, as stated previously, disadvantaging students contravenes the BERA ethical code. Finally, although participants' perceptions on the impact of the spreadsheet on learning were positive, it is difficult to measure the actual impact on learning. A design using pre and post intervention grades would go some way to investigating this, but several confounds would still remain. However, despite these shortcomings, this study achieved its overall aims and many lessons have been learned.

Conclusions and further work

The spreadsheet was well received and evaluated positively by the participants. The act of recording reflections was simplified by using prompts to encourage students to engage in reflective practice. The properties of the spreadsheet facilitated the desirable and necessary cyclical nature of reflective practice to be achieved.

The spreadsheet has been updated to include a column headed, 'How can I apply what I have learned?' Because of the positive evaluation, this version is now available, via SSU's VLE, to all undergraduate students enrolled on Psychology courses at SSU ($n = 300$). Use is entirely voluntary, no course credit is given and entries are neither monitored nor assessed. However, online and individual help is available as and when required. To date approximately 20% of students are using the spreadsheet regularly and informal feedback has been positive.

A follow up study, '*Reflecting and Learning: Sharing Experience*' (ReaLiSE), is underway. ReaLiSE incorporates a spreadsheet with an additional column to prompt users to consider how they will apply what they have learned in future. More importantly, ReaLiSE incorporates a database which has been populated with data from the study reported in this paper. Participants in ReaLiSE have the option of reflecting on and possibly learning from these reflections, as well as uploading some or all of their own reflections to share with others. This increases the potential value of reflective practice from that of individual introspective, to shared communication. All reflections remain anonymous and each participant maintains control over what is uploaded.

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Appendix A

Raw data

Theme	Participant										Total
	1	2	3	4	5	6	7	8	9	1	
Achieving	1	2	0	2	2	2	3	3	2	2	19
Breaking Info Down	1	5	1	1	1	1	9	5	9	5	53
Communication	1	9	0	0	2	3	8	5	4	4	36
Feelings	4	1	3	2	1	1	1	1	2	1	125
Negotiation	0	1	0	0	4	1	2	0	2	1	11
Organisation	1	9	3	1	3	6	1	7	6	8	71
Reading	0	4	4	0	6	4	8	3	4	2	35
Researching	1	2	0	4	0	0	1	0	1	1	10
Revising	0	0	0	4	1	0	0	0	0	0	5
Totals	9	4	1	5	3	3	5	4	4	3	365

Table 1 Themes

Topic	Count
Critique a journal paper	10
Debate	2
Essay/report	6
Peer review	2
Prepare/write a lab report	6
Presentation	9
Revision	1
Specific unit topic	5
Statistics	5
Total	46

Table 2 Topics