Helping students in HE succeed through using reflective practice to enhance metacognition and create more realistic predictions

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Abstract
Understanding how students can better manage their expectations has been a topic of interest in pedagogy for some time, yet solutions remain elusive. This paper describes a recent study in which more accurate predictions were made following a 6-week intervention aimed at increasing metacognition. At the outset, participants completed a metacognitive awareness inventory and were asked to predict the submission time and grade for their next assessment. They were instructed on using a structured reflection spreadsheet and asked to reflect weekly for the study period. At the end of the study, the inventory was re-administered and participants predicted the submission time and grade for the next assessment. Although results showed a significant increase in scores on the metacognitive awareness inventory, scores were found not to be a strong predictor of estimation error. Possible reasons for the outcomes and further work are discussed.

Keywords
Metacognition; student satisfaction; expectation; reflection

1. Introduction

In an attempt to manage the complexity of processing mental tasks, such as making predictions, humans use heuristics (Simon, 1957), readily available experience-based techniques, to derive a satisfactory prediction. People have high confidence in heuristic-based predictions (Fischhoff, Slovic & Lichtenstein, 1977) despite evidence suggesting they can differ significantly from actual outcomes (Dunning, 2005; Tversky & Kahneman, 1974) because they are typically biased towards overestimation of ability, skills and knowledge (Dunning, Heath & Suls, 2004). This incongruence can result in dissatisfaction which in turn determines students' expectations (e.g., Moore, Moore & McDonald, 2008; Appleton-Knapp & Krentler, 2006). A great deal of importance is based on satisfaction ratings as they can affect the reputation of a Higher Education Institution (HEI), tutor evaluations (2008) and attrition rates. While it is clearly in the interest of all to improve satisfaction, there is a paucity of research investigating the relationship between prediction accuracy and satisfaction ratings. Rather, findings from studies investigating student satisfaction typically encourage staff to provide environments that surpass student expectations (e.g., Ferguson DeJong, 2008). In addition to prediction bias, weak correlations have been found between self-perceptions of knowledge and objective performance (e.g., Dunning, Johnson, Ehrlinger & Kruger, 2003; Fischhoff et al., 1977; Buehler, Griffin & Ross, 1994).

More accurate self-perceptions can be developed through increased metacognition (e.g., Flavell, 1978; Swartz and Perkins, 1989). This allows students to become more autonomous and take

responsibility for learning (Boud, 1995). Therefore, students should be encouraged to develop awareness, control of and knowledge about cognitive processes (Livingston, 1997). Metacognition

has been found to be a predictor of successful learning and academic performance (e.g., Dunning et al. 2003), intelligence (e.g. Sternberg, 1984) and confidence (Kleitman and Stankov, 2007). Self-report measures such as the Metacognitive Awareness Inventory (MAI; Schraw & Dennison, 1998) aspects of metacognition such as critical reflection (e.g., Schön; Dewey, 1939b). Therefore, developing critical reflective practice can improve metacognitive awareness.

In order to learn from reflective practice, weaknesses as well as strengths need to be scrutinized (Dewey, 1939b). However, when reflections are read or assessed, students tend to demonstrate knowledge and hide ignorance (Boud, 1999; Sumsion & Fleet, 1996). Using information and communication technology (ICT) for reflective practice could be advantageous, for example, by increasing honesty (Kettinger & Grover, 1997). Additional advantages of ICT have often been cited (e.g., Barak, 2006; Paulus & Roberts, 2006; Aleven and Koedinger, 2002; Lin, Hmelo, Kinzer & Secules, 1999). Mair (2009) developed a structured spreadsheet, situated on the University's VLE. Recorded reflections were not read or assessed in order to encourage analysis of weaknesses and well as strengths. Findings showed improved metacognitive awareness.

In sum, given that predictions are typically based on heuristics and there is a weak correlation between self-perceptions of knowledge and objective performance, it is not surprising that students' expectations typically do not correspond with outcomes. This dissonance can lead to low satisfaction ratings. In order to derive more realistic self-perceptions, students are encouraged to develop metacognitive awareness often through reflective practice. In order to determine the relationship between metacognition and prediction accuracy, participants in the present study were encouraged to reflect critically for 6 weeks and to predict the outcome of 2 assessments. The hypotheses are that (i) reflective practice will lead to increased metacognitive awareness and (ii) a relationship exists between metacognitive awareness and prediction accuracy.

2. Method

2.1 Participants

Ethical approval was obtained from the Department's Ethics Committee prior to commencement. Year 2 undergraduate psychology students were asked to complete the MAI and reflect weekly on their learning via the VLE for 6 weeks as a 'structured learning' exercise in part fulfillment of their coursework. Fifty-five students consented to their data being used for the purposes of this study.

2.2 Materials

The Metacognitive Awareness Inventory (MAI) (Shraw & Dennison, 1994) was used to measure self-reported metacognitive awareness. The 52-item MAI measures a range of aspects of metacognition such as monitoring, planning, comprehension using a 6-point Likert scale. A structured spreadsheet for reflecting based on Mair (2009) was used to encourage reflective practice on learning.

2.3 Procedure

The study required students to (i) complete the MAI, a self-report metacognitive awareness measure, before and after the study, (ii) predict the time and date they would submit their next assignment (A1) and the grade they would be awarded for it, (iii) reflect on their learning using a structured reflection spreadsheet and (iv) at the end of the study, predict the time and date they would submit a second assignment (A2) and the grade they would be awarded for it. At the outset, participants were instructed on using the reflection spreadsheet. Baseline and post-study scores from the MAI were compared, and students' predicted submission times and marks were compared with actual submission times and marks for A1 and A2.

3. Results

Fifty-five participants completed the Metacognitive Awareness Inventory (MAI) at the outset. Some dropped out after this point. The others predicted the submission time and mark for their next assignment (A1) and began reflecting using the spreadsheet. However, over the weeks, many others withdrew from the study. At the end of the study, the remaining participants were again asked to complete the MAI and predict the submission time and mark for their next assignment (A2). 39 participants completed the MAI, but 3 of these did not make predictions, hence were excluded from the analysis in this paper. The results described below are from the remaining 36 participants.

Variable	Mean	Median	StdDev	Min	Max
MAI pre	212.39	209.5	22.88	165	271
MAI post	222.78	218	24.18	177	283
A1 Time Error	12.75	11.25	16.64	-35	48
A1 Mark Error	-2.14	-2	10.28	-28	18
A2 Time Error	67.85	16	130.67	-70	432
A2 Mark Error	-0.96	-1	8.06	-18	18
A1 Abs Time Error	16.44	12.5	12.89	1	48
A1 Abs Mark Error	7.58	6	7.16	0	28
A2 Abs Time Error	77.18	21.75	125.23	0.5	432
A2 Abs Mark Error	6.49	5.75	4.76	0	18
Number Reflections	3.83	4	2.06	0	6

Table 1 Descriptive statistics (n=36) mean, median SD and range for MAI scores pre and post-study, the error for submission time and mark for A1 and A2, and the number of reflections

3.1 Metacognitive awareness inventory

97% of participants increased increased their MAI scores over the study period by a mean of 10.4. The Wilcoxon signed rank test (2-tailed) was significant ($p \leq 0.0001$). Other descriptive statistics for MAI scores are in Table 1.

3.2 Prediction accuracy

Results from participants' predictions for the submission time and mark for their next assignment (A1) are below and tabulated in Table 1. 81% participants predicted they would submit A1 before they actually did. That is they were over-confident (median over-confidence = 11.5 hours). However, 54% participants were under-confident when predicting marks for A1 (median was -2 marks). Again, 81% participants predicted they would submit A2 before they actually did (median over-confidence = 16 hours). Of these, 7 predicted they would submit at least 10 days sooner than they did. However, half the participants were under-confident when predicting their mark for A2 (median = -1).

3.3 Reflective practice

Participants were instructed to reflect using the online spreadsheet each week for the duration of the study. However, each week fewer particpants did this (52, 42, 34, 39, 22, 17 from week 1 to week 6 respectively). Count of reflections is tabulated in Table 1.

3.4 Relationship between metacognitive awareness and prediction accuracy

Cross correlation analyses were conducted on pre-study MAI scores with predictions for A1.

	MAI pre	A1 Abs Time Error	A1 Abs Mark Error
MAI pre	1.000		
A1 Abs Time Error	0.235 ***	1.000	
A1 Abs Mark Error	-0.082	-0.013	1.000

Table 2 Spearman Rank cross-correlations: pre MAI scores with absolute prediction errors for A1

	MAI post	# reflections	A2 Abs Time Error	A2 Abs Mark Error
MAI post	1.000			
# reflections	0.029	1.000		
A2 Abs Time Error	-0.157 **	-0.291 ***	1.000	
A2 Abs Mark Error	-0.140 **	-0.038	-0.094 *	1.000

Table 3 Spearman Rank cross-correlations: post MAI scores with absolute prediction errors for A2 and number of reflections

The correlations show (i) significant correlations between baseline MAI scores and error in predicting submission time for A1 and A2 (Table 2), (ii) post-study MAI scores and error in predicting the mark for A2 and (iii) the number of reflections and error in predicting time for A2 (Table 3).

4. Discussion

In general, expectations are built on heuristic-based predictions which are likely to be biased towards overestimation of ability. Dissonance between predicted and actual outcomes can lead to dissatisfaction. Programmes aimed at increasing metacognition, such as critical reflection, can enable students to improve self-perceptions of knowledge and skills and increase confidence. However, although enhanced confidence can lead to better performance, it can also lead to unrealistic (biased) expectations (Kleitman & Stankov, 2007).

In the present study, MAI score was found not to be a strong predictor of estimation error. However, the higher baseline MAI score, the worse the prediction error for A1 submission time. *A priori* one might expect a negative correlation as higher scores associate with lower absolute errors. Notwithstanding the number of reflections made, participants increased their metacognitive awareness scores over the period of the study. Because there is no relationship between number of reflections and increase in MAI score, it is not known if these scores would have increased regardless.

Predictions for A2 submission time were more over-confident than those for A1. This supports evidence which suggests confidence increases with increased metacognitive awareness (Kleitman & Stankov, 2007). This supports Tversky & Kahneman (1974) and others who argue that because predictions are generally heuristics-based, they are typically biased towards overestimation of ability, skills and knowledge. The participants believed they could complete the assignment in less time than they actually needed. However, in contradiction, participants were under-confident with regard to predicting their marks, although the marks for A2 were better predicted than the marks for A1. Despite this there is no evidence of collective bias. There could be many reasons for the under-confidence. For example, the marks were predicted in a seminar setting rather than in private. Thus the lower predictions could be the result of false modesty. Furthermore the University introduced a new policy regarding late submissions between the deadline for A1 and A2. Accordingly, submissions can now be made up to 2 weeks (10 working days) late with only 3 penalty marks; whereas previously, the deadline was 5 days late with 10 penalty marks. This could be a contributing factor for the 7 participants who predicted they would submit up to 2 weeks before they actually did.

Larger errors were found in prediction of time than of marks, but this could be due in part to the larger scope for error in predicting the former. The predicted mark was closely related to previous actual marks. This suggests participants were not using all the knowledge available to them such as variation in assignment requirements. Predictions were made with no general discussion on predicting and the associated biases (e.g., Simon, 1957; Fischhoff et al., 1977; Dunning, 2005; Dunning et al., 2004; Tversky & Kahneman, 1974). Thus participants were likely to guess rather than calculate predictions.

5. Conclusions

Students arrive at university with high expectations and consequently become dissatisfied when actual outcomes do not correspond with their expectations. The resulting disappointment can lead to a sense of injustice, provision of poor feedback on staff and increased attrition rates. In order to address this issue, we need to understand how expectations are derived and how best to help students manage them. Typically humans make predictions based on heuristics which are prone to many cognitive biases. In the study reported here, structured critical reflective practice was encouraged to help students develop metacognitive awareness in order to make more realistic predictions. However, although there were weak correlations between metacognitive awareness and prediction error, the effects are small and shouldn't be considered predictive.

The study findings were limited. For example, for ethical reasons, there was no control group; the large drop-out resulted in a small sample size; no prior information was given on prediction biases to participants; and predictions were neither made in private nor justified. An extension of this study will ask that predictions are made privately with justification (explanations of derivation); and critical reflection on prediction error will be encouraged to improve future predictions. Future work should

continue to encourage the development of students' metacognition with an emphasis on developing accurate self-perceptions. Ultimately this should help generate more realistic predictions.

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