Engaging students in optimising their meta-cognition and self-regulation through individual cognitive feedback and peer coaching

Initial End of Year One Report

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This report was produced as part of an internal review process of a pilot programme commissioned by Dr Mark Lowman and Dr Simon Walker, Jo Walker and Dr Roz Sunley within the Business School in 2014-15. The programme was part of the Semester Two Academic and Professional Studies module designed by Dr Sunley for Year One students.

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1. Introduction

Contemporary research shows that undergraduate business students are taking an increasingly instrumental approach to learning (Colby et al 2011) and seeking the shortest possible route to academic success, often at the expense of any real personal engagement with learning. First year students have also been shown to experience difficulty adapting to university life (Torenbeek et al 2011), and 'poor student experience in the first year contributes to withdrawal' (Kraus et al 2005 cited Torenbeek et al). Employers value communication and team skills, self-motivation and self-confidence, so as universities widen participation, it becomes increasingly important to help students, from a diverse range of backgrounds, develop meta-cognition to enhance their engagement with learning and preparation for employment.

This research project aimed to develop student engagement, by improving students' meta-cognition, self-awareness and self-regulation as they transition into higher education to become independent learners. Using a measure of learning called Cognitive Affective Social state (CAS), first year students were provided with feedback on their cognitive, affective and social engagement in relation to different elements of their first year studies. In addition, students were equipped with new learning strategies to support the development of their academic and professional skills and self-knowledge as part of their first year transition into at university.

1.1. Anticipated outcomes

- Evidence that demonstrates growth in metacognition and self-awareness in the form of comparative CAS scores and summative assessments.
- Evidence that students have acquired a wider repertoire of learning strategies from which they can select their own optimal learning approaches, as part of the development of academic and professional skills, and the self-knowledge and personal attributes that are fundamental to students' future employability.
- Feedback from evaluation of new programme content and pedagogy, to inform the continuing development of management education in the Business School
- Research data that may be shared within university and disseminated as part of knowledge exchange in the wider academic community.

1. Methodology:

This study used a measure of cognitive self-regulation called Cognitive Affective Social state (CAS). The CAS construct was developed from research carried out by Dr Simon Walker (Human Ecology Education) over 15 years into UK schools and leaders. Links to CAS research papers and videos can be found at:

http://simonpwalker.com/#/research-publications/4587873262

http://simonpwalker.com/#/research-blog/4538398531

CAS is a measure of the ability to adjust one's cognitive state for the learning task in hand. The CAS construct is composed of 7 components or factors:

- *trust of self,*
- *trust of others,*
- *self-presentation,*
- *embracing change,*
- *perspective,*
- *processing and planning*

(Walker 2007, 2009, 2015d). Each of these components can be individually regulated between learning tasks to adjust for the demands of the task. Prior studies have shown that effective students adjust the components of their CAS state when engaged in different learning tasks. Less effective students either fail to adjust their CAS state, or adjust it sub-optimally. Ability to adjust CAS state has been shown to account for up to 15% of academic outcomes at GCSE and A level over and above IQ-like scores (Walker 2014 g., 2015d).

Unlike IQ-like scores, CAS can be improved through training (Walker 2014 b.). Feedback directing students to poor self-regulation of CAS can improve the conscious control of the mind toward a more optimal CAS state for the specific learning activity. Re-measuring CAS state after a period of training can evidence quantitative changes, including improvements, in CAS that may be correlated with or attributed to specific training interventions.

Semester 1:

All first year management students (approximately 175) were invited to complete the online CAS questionnaire in week 6 of their first twelve week semester, following a presentation of the research project. CAS assessments provided feedback on first year students' cognitive, affective and social engagement with 6 specific learning tasks contributing to their course: ***giving a presentation, data analysis, individual work, group work, summative assessment, peer review.***

Students received individual CAS feedback reports in week 11 to help them review themselves as learners at the end of semester 1 in relation to each of these 6 learning tasks. Their individual reports suggested a range of specific, bespoke strategies to help them target areas for developing their meta-cognition and self-regulation for each task.

Semester 2:

In semester 2, students participated in a designed set of learning interventions to improve learning, as part of a new Continuing Academic & Professional Studies module. The module included four fortnightly opportunities for students to engage in peer coaching. Peer coaching training was provided by lecturers within the module. The focus of the peer coaching could include specific identified CAS targets, as well as a wider range of personally identified areas for development. The module also included other opportunities to engage in broad learning experiences and processes, including wider reading, undertaking creative group-learning activities and engaging in community activities.

Students CAS scores were re-measured in week 9 of semester 2, following regular fortnightly peer coaching sessions between weeks 1-8, in the light of printed feedback from the end of semester 1. This allowed any improvements in CAS state to be analysed, providing a measure of interventions designed to improve student learning. Students were required to reflect on their learning from peer coaching as part of their end of semester assessment portfolios.

A participant survey was used at the end of the second semester 1st year academic and professional skills module to elicit student attitudes to, understanding of and engagement with, the programme.

2. Results

66 students completed CAS 0 times, 43 students completed CAS one time (at the start), 32 students completed CAS twice (at both start and end). Number of completions of CAS was distributed across ability ranges (judged by marks obtained in module 1), though low scorers completed CAS slightly less than higher scorers.

2.1 Descriptive correlations between CAS engagement and module scores

Completion of CAS 0 times was assumed to indicate a low level of engagement with this aspect of the module process. Completion 1 time (i.e. in week 6 of module 1 but not repeated at the end of module 2) was assumed to indicate a diminishing level of engagement with this aspect of the module process. Completion 2 times was assumed to indicate a continued level of engagement with this aspect of the module process over the duration of course.

Figure 1. shows the relationship between number of CAS completions and the percentage difference in scores between module 1 and 2. Students who completed CAS 0 times exhibited a mean *decrease* in score between module 1 and 2 of -8.4%. Students who completed CAS 1 time exhibited a mean *decrease* of -2.6%. Students who completed CAS 2 times exhibited a mean *increase* in score between module 1 and 2 of + 6.4%.

Number of times	1st module	2nd module	Difference	%
0	55.5	51.3	-4.3	-8.4
1	57.9	56.4	-1.5	-2.6
2	58.1	62.1	4.0	6.4

Figure 1.

Student data was then split into cohort score bands in order to identify the effect of CAS completions on high vs low performing students. Cohort bands of scores between 40-50, 50-60 and 60-70, achieved in module 1, were used and students assigned to respective cohort bands based on their scores. The hypothesis was that students who scored low in module 1 would, by the principle of regression toward the mean, be more likely to exhibit improved scores in module 2 compared to their low module 1 simply by random effect. By contrast, high performers in module 1 would correspondingly be more likely to show a decrease in their module 2 score. Results shown in Figure 2.

40-50 band students who completed CAS 2 times showed the greatest increase in module scores compared to 1 or 0 completions, indicating that higher CAS completions correlated with the in improved module scores over and above regression to the mean.

Similarly, *50-60 band students* who completed CAS 2 times showed an increase in module score, whilst those who completed only 1 or 0 times regressed downwards toward the mean from module 1 to 2.

Similarly, *60-70 band students* who completed CAS only 1 or 0 times showed regressed to the mean, showing large decreases in scores between module 1 and 2. By contrast, students who completed CAS 2 times resisted regression to the mean, maintaining their high scores into module 2.

These results indicate that those students who completed CAS twice showed consistently higher improvements in their scores between module 1 and 2, than those students who completed 0 or 1 time. These results are illustrated graphically in Figures 3,4, 5 and 6.

Number of times CAS	Cohort score	Mean module	Mean module	Difference
0	40-50 band	40.7	39.8	-0.9
0	50-60 band	56.3	52.4	-4.0
0	60-70 band	69.6	61.6	-8.0
1	40-50 band	45.0	51.1	6.1
1	50-60 band	58.6	56.9	-1.7
1	60-70 band	70.1	61.1	-8.9
2	40-50 band	44.0	52.0	8.0
2	50-60 band	59.4	63.9	4.5

Figure 2. Differences in marks between module one and module for 'grade bands' for each group of CAS

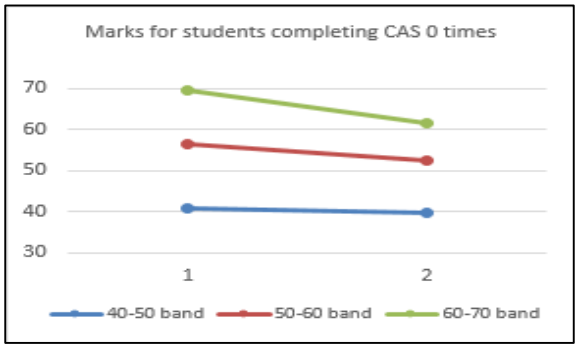

Figure 3. Change in marks between module 1 and 2 for students completing CAS 0 times.

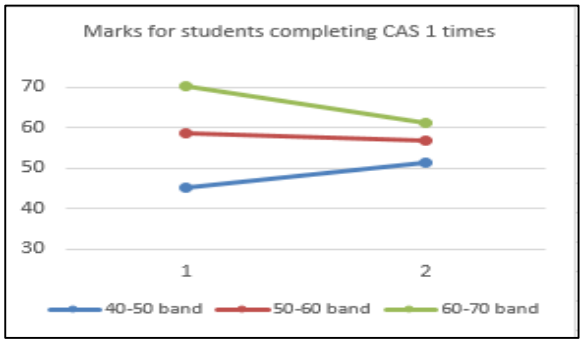

Figure 4. Change in marks between module 1 and 2 for students completing CAS 1 time.

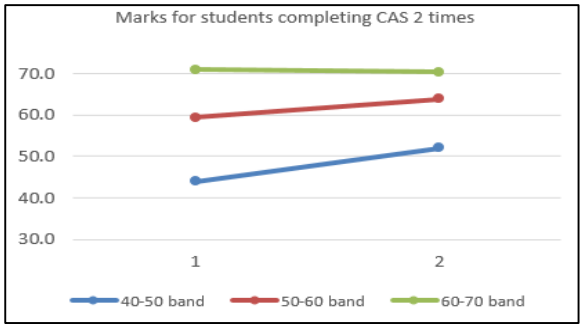

Figure 5. Change in marks between module 1 and 2 for students completing CAS 2 times.

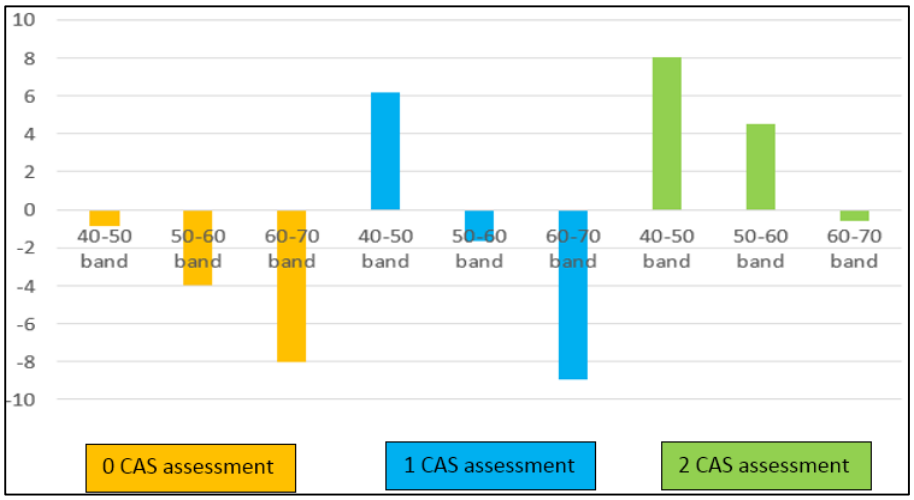

Figure 6. Mean difference in module 1 and 2 marks for students who completed 0, 1 and 2 CAS assessments.

These results support the conclusion that students who completed CAS on both occasions showed a significant increase in their second module scores compared to their first module scores. Engaging more deeply with CAS appears to be a reliable indicator of improved student engagement, and thereby of student marks, in module 2.

2.2 Causal effects of improved CAS self-regulation

The question then is, is there evidence that engaging with CAS has had any causal effect on improved marks in module 2?

Data from students who completed CAS 2 times was analysed to identify first how CAS scores had changed between assessments 1, undertaken in December 2014,and 2, undertaken in March 2015. Charts showing the difference in component factor scores of the CAS construct, between assessments 1 and 2 were generated. A number of these component factors showed an obvious visible difference between the first and second CAS assessment. For example, in the learning task 'Giving a presentation', the cohort self-disclosure scores increase between the first and the second CAS assessment (Figure 7). This is compatible with the strategic guidance given in the individual CAS student feedback that giving a presentation requires a higher degree of self-disclosure. The result indicates that students responded to the strategic guidance between assessments 1 and 2, improving their self-regulation of CAS for the specific task, by increasing their self-disclosure.

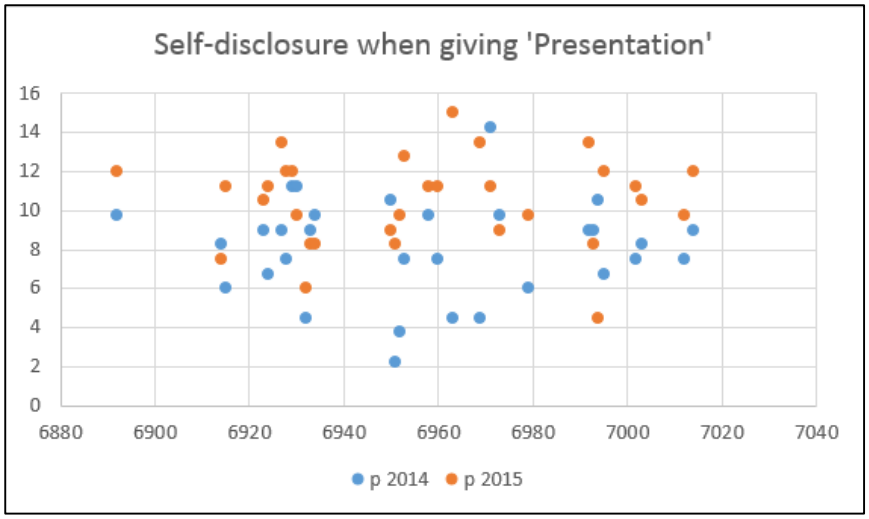

Figure 7.

Similarly, specific student guidance indicates that, when giving a presentation, a higher trust of others is more optimal. Cohort scores shown in Figure 7. Indicate that students increased their trust of others in response to the specific feedback, thus improving their CAS self-regulation for that specific learning task..

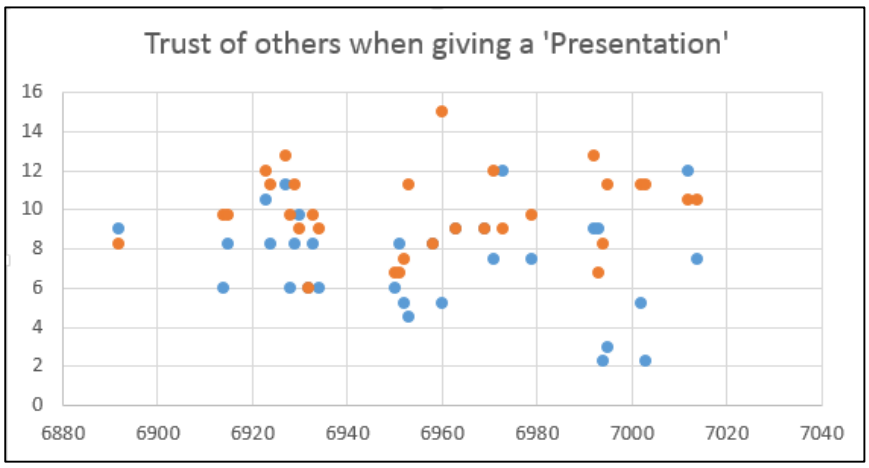

Figure 8.

Other CAS components showed similar improvements toward the optimal for other specific learning tasks. These results suggest that the specific, individual CAS feedback to students had a measurable effect on cognitive self-regulation of those students *specific to the learning task*. Generic changes in factor scores across all learning tasks was not observe. This indicated that students differentiated when and how to adjust their CAS scores according to the learning task in hand, evidencing context-specific improved metacognition and self-regulation.

2.3 Significance tests

These initial indications of improvements were then analysed using statistical methods to establish significance. Two significance tests were performed.

First, a test of whether student self-regulation had improved ***across tasks*** between assessment one and two. Student's ability to self-regulate their CAS state can be evidenced by the spread, or variance, shown across their array of 'learning task CAS scores'. More moderate adjustments have been found, in previous studies, to correlate with better academic outcomes than more extreme adjustments. A student with a wider spread, or variance, across their scores effectively shows poorer cognitive self-regulation than a student whose scores are more moderately adjusted from task to task. To assess this, the variance of individual students CAS regulation scores across learning tasks was analysed for the first assessment, and then for the second assessment (Figure 9.)

Mean standard deviation	Self-disclosure	Trust of self	Embracing change	Trust of others	Perspective	Processing	Planning
First assessment	2.874231	2.381444	2.667311	2.628941	1.846499	2.015198	2.345884
Second assessment	2.496094	2.056495	2.384606	2.211391	1.753697	1.753526	2.027632

Figure 9.

A paired two-tailed T-test for was used measure the significance of the difference between the two standard deviation score sets. There was a significant difference in the scores for the first assessment (M=2.39, SD=0.13) and the second assessment (M=2.09, SD=0.08) conditions; t two tail (= 2.44), p = <0.005.

These results indicate that the mean variance across a student's scores in 2015 had significantly decreased from their mean variance in 2014. Students who engaged with their feedback from their CAS assessments had become more closely cognitively self-regulating by 2015, evidencing that improved CAS self-regulation is likely to have been a factor in improved module grade scores.

Second, a test of whether student self-regulation had improved ***within a task*** between assessment one and two. Student's ability to self-regulate their CAS state can be evidenced by a tighter cluster of cohort CAS scores for any single learning task. For example, when 'giving a presentation' a tighter clustering of student CAS scores for that task, leading to greater difference of CAS scores between tasks as opposed to within a task, would indicate that a population had collectively shifted to adopt a more intentional CAS state for that task. By contrast, a looser clustering of student CAS scores for that task, leading to a lower difference of CAS scores between tasks, would indicate there was little evidence that group was clustering intentionally around a specific response to any single task. Instead, a more diverse, diffuse and random set of responses would exist.

The tightness of cluster of CAS scores for each of the kinds of learning task was first calculated (Figure 10). An overall mean of tightness of cluster was calculated. This process was repeated for both first and second assessments, providing two comparative data sets.

Mean standard deviation	Self-disclosure	Trust of self	Embracing change	Trust of others	Perspective	Processing	Planning
First assessment	3.019401	2.335737	2.679943	2.547388	1.861979	1.727926	1.995196
Second assessment	2.229222	1.846651	2.524026	2.112749	1.263172	1.474815	1.782459

Figure 10.

A paired two-tailed T-test for was used measure the significance of the difference between the two standard deviation score sets. There was a significant difference in the scores for the first assessment (M=2.30, SD=0.22) and the second assessment (M=1.9, SD=0.19) conditions; t two tail (= 2.43), p = <0.005.

These results indicate that the tightness of the cluster of CAS scores for a particular learning task in 2015 was significantly tighter from the tightness of cluster CAS scores in 2014. The cohort of students who engaged with their feedback from their CAS assessments had cognitively self-regulated toward task-specific CAS states rather than individually or randomly determined CAS state. This result evidence that improved CAS self-regulation toward an intentional task-specific CAS state is likely to have been a factor in improved module grade scores.

2.4 End of module student engagement surveys

79 students completed end-of-module engagement surveys. A variety of free text and ratings scale responses were recorded. Ratings scales of 1-10 were used, 1 being a low response to the question and a 10 a high response. The questions were designed to elicit the degree to which a student had chosen to engage with the module processes and learning activities including peer coaching, wider reading CAS assessments and feedback and engagement in the community. Student surveys were anonymous, therefore it was not possible to compare engagement scores with improvements in CAS scores, or improvements in scores between module 1 and 2.

Engagement with CAS and high overall engagement:

31 students scored between 7-10 for engagement and cited specific CAS factors worked on during module as barriers to learning which they had sought to overcome. All 31 students identified improvements in learner/learning as a result of improving CAS factors. CAS factors identified explicitly by more than one student included: *Improved trust of self/confidence, improved peer work, improved trust of others, improved attitude to risk taking, improved approach to planning.*

Non-engagement with CAS but high overall engagement:

32 students indicated 7-10 for engagement and did not cite CAS factors as relevant to their engagement. These students identified other factors which were barriers to their learning, which they had sought to overcome through the module. All 31 identified improvements in learning as a result of working on those factors. Typical factors worked on included: *Time management, reading, expressing oneself, creativity.*

In addition, 3 students indicated engagement but identified more basic learning difficulties which may have held back their learning. Some students indicated wider ecological factors (such as housing, money and distance to travel) as the most significant obstacles to learning, none of which were specifically targeted through the module processes).

Low overall engagement:

13 students indicated low engagement (6 or lower) and that they gained relatively little from the course.

These results indicate that for about 45% of respondents improvements in their learning were related to other factors than CAS- including improving time management, reading, expressing oneself and creativity. Other, wider ecological concerns were also factors in improving or inhibiting learning.

For a further 45% of survey respondents, CAS factors were an explicit part of their engagement with the module, and their improvements in CAS self-regulation were an acknowledged benefit from the module.

3. Discussion

3.1 The effect of conscientiousness.

It is likely that students who completed CAS twice were more conscientious in nature than others. Despite this conscientiousness, these students performed less well in the module prior to the study module compared to their peers. The evidence suggests that CAS, within with context of peer coaching, provided the structure, map, guidance and targeted individual feedback for the conscientious to channel their effort much more effectively. As a result, they improved *disproportionality compared to their own previous module result.*

Overall, these results support a conclusion that students who exhibited the highest improvement in module two marks compared to module one also showed significant improvements in CAS self-regulation. These students were more intentional about the CAS state they adopted for a specific learning task, choosing to adopt a more optimal CAS state. These students were also more considered and moderate in their self-regulation as they moved between different learning tasks, reducing extreme or dis-regulated cognitive regulation. These results together indicate an improvement in *student metacognition and self-regulation* as a result of engaging in the module process.

3.2 Improving student metacognition and executive function

A large metastudy conducted by the UK Education Endowment Fund showed that improving metacognitive was one of the most effective methods of accelerating primary and secondary student academic performance. Our results evidence that improving metacognition through improving CAS self-regulation can also improve higher education academic outcomes (Education Endowment Fund 2014).

Metacognitive execution functions are required to overcome varied epistemic challenges. Executive function is an umbrella under which many neural circuits implicated in *ad hoc* cognition are swept (Elliott 2003; Banich 2009) and is closely related to metacognition (Halloran 2011; Miyake et al. 2000; Fernandez-Duque et al. 2000). CAS state self-regulation provides an explanation of how higher education students can consciously learn to adjust their cognitive focus, or strategies, as they engage in epistemically different tasks e.g. giving a presentation, running data analysis or working in a team.

In this study, importantly, students did not show blanket changes in their CAS factor scores across all their learning context simulations. Instead, appropriate factor changes were identified in specific learning contexts. For example, student self-disclosure went up when giving a presentation, but remained the same when engaged in peer review or final assessment. Student trust of others went up when giving a presentation, but remained the same when engaged in debate.

These differentiated results indicate that students did not universally become more self-disclosing, or more trusting of others, as a result of generic factors such as having got to know each other better by semester two. Instead, students differentially shifted in certain specific CAS factors in response to a better, more contextual understanding of the requirements of each specific learning task.

This result supports the conclusion that the metacognitive ability of students to identify, select and execute the appropriate cognitive and social strategies for the task in hand was improved by the CAS-based feedback and coaching.

These improvements in metacognitive self-regulation support earlier primary and secondary school studies by the researchers, which evidenced that improving student CAS self-regulation can improve academic outcomes. In a previous series of experiments with secondary school students, Walker (2014 g.) provides evidence that regulating of CAS state differentially between maths, english and science lessons explains around 15% of academic outcomes and school rank not explained by CAT (IQ) score (Walker 2014 g.).

Whilst it can never be definitively proved that these improvements in CAS caused improvements in student module scores, improvements in metacognition and self-regulation, which are the specific improvements generated by CAS training, have been shown by wider research to have significant positive effects on academic outcomes.

3.3 Improving student self-regulation and mental health

These results also suggest that improving higher education student self-regulation may also improve *wider* outcomes than the merely academic. Previous studies have shown that self-regulation of CAS state is a factor explaining lower secondary school pupil welfare and mental health (Walker 2015d). Walker J has identified that dysregulated biases in CAS state and over-regulated biases are potential causes of wider self-regulatory problems (Walker 2015c, 2015a, 2015b).

Students with *better self-regulation of CAS* are more likely to *read* the particular situation, encounter or context; they notice extrinsic and intrinsic cues which lead them to purposefully choose a particular affective-social response (Rothbart et al. 2000a; Eisenberg et al. 2000; Halberstadt et al. 2001; Tangney et al. 2004).

In contrast, students who develop a *poor self-regulation of CAS* are less likely to notice those extrinsic and intrinsic cues; they tend to iterate the same self-strategies again and again which further reinforces their bias. These pupil can be said to have poor self-regulation; poor self-regulation predisposes them to a number of incipient risks (Eisenberg et al. 2003; Sallquist et al. 2009; Simonds et al. 2007).

The ability to self-regulate has been identified as a foundational developmental skill which underpins future affective, social and academic competence (Vohs et al. 2008); in contrast, poor self-regulation has been found to correlate with a wide range of internalising and externalising difficulties (Eisenberg et al. 2000; Blair 2002; Trentacosta,C.J., & Shaw, D.S. 2009; Tangney et al. 2004). Critically, self-regulation involves the ability to flexibly activate, monitor, inhibit or adapt one's non conscious, automatic affective-social strategies in response to direction from internal cues, environmental stimuli or feedback from others, in order to bring about an intended outcome (Rothbart et al. 2000b; Demetriou 2000; Eisenberg N. et al. 2006). As such, it is often effortful, volitional, conscious and purposeful (Eisenberg et al. 2000; Eisenberg et al. 2010; Hofer et al. 2010; Rothbart, Bates 2007; King et al. 2013, Bauer, Isabelle, M., Baumeister, Roy, F. 2011, 2011), and is sometimes described as effortful control.

As such, improving higher education student self-regulation through CAS training may similarly have wider benefits for student psychological health and wellbeing.

3.4 Next steps

An opportunity to run a second pilot study in 2015-16 is being designed. This would seek to overcome some of the challenges in the implementing of the first study. A second pilot would specifically provide the opportunity to reduce the staff time involved in recruiting and retaining the participation of students in the process, by improving the methodology.

In particular, engaging a greater proportion than 50% of the students would be likely be achieved by several measures. These include,

- first, a clearer explanation to the student cohort of the benefits of the process;
- second, a fuller explanation of the particular nature of the CAS assessment, and underlying cognitive theory. There is anecdotal evidence that the unusual nature of online assessment, which involves using one's imagination, may have bred caution in some students whose willingness to engage was already marginal;
- third, overcoming the technological and human faults in the CAS assessment process itself, by better supporting students during their assessments and by using Human Ecology's revised CAS assessment technology.
- Finally, utilizing the positive testimony of the first study cohort would encourage students to commit to the process in this coming year.

4. Conclusions

Results after the first year of this study indicate clear correlations between improved student academic outcomes and improved CAS scores. Embedded within a module programme that facilitated learner self-reflection, peer coaching and risk-taking, students who engaged with the programme exhibited improved CAS scores and associated improvements in academic outcomes.

It is likely that a virtuous circle was created in which direct, and targeted individual feedback, alongside ecological, pedagogic and peer support, provided a context in which students could take ownership of their capacity as learners and accelerate the development of their skills as learners.

The study, to date, suggests that lack of willingness to engage with CAS and the wider module learning opportunities, is the greatest inhibitor to improved student outcomes. In other words, you can lead a horse to water but you cannot force it to drink. Those that do drink, however, quickly distinguish themselves from those that don't by their subsequent improved performance and learning skills.

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