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Embedding the development of graduate qualities of international postgraduate IT students in the disciplinary curriculum

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There has been a steady increase in international students pursuing postgraduate coursework education in English speaking countries. Like first-year undergraduate students, these international students need assistance transitioning into the new educational environment and preparing for self-directed, collaborative learning throughout their careers. Drawing on the social constructivist pedagogical approaches, we developed learning tasks that foster self-regulation and collaboration among postgraduate coursework IT students, aligning these tasks with the learning outcomes of the subject *Information Design and Content Management*. This paper presents the rationale and method for the design of the learning tasks, and how these learning tasks to not only align with the subject learning outcomes but also facilitate self-regulation. A study involving pre- and post-subject surveys and interviews with 133 subject students will provide us with further insights into the effectiveness of the learning task design and the areas for improvement.

Keywords: International postgraduate students, self-regulation, social constructivism, graduate qualities

Introduction

In the last three decades, there has been a steady increase in international students pursuing postgraduate education in English-speaking countries, e.g., U.S.A., U.K., Australia, and Canada. In June 2020, there were 637,415 international students in Australia (Australian Government, 2020). International education not only brings in economic benefits and intellectual capital for the host countries but also enhances educational, linguistic, social and cultural diversity (Phakiti et al., 2013). International students are the ambassadors for cultural exchange and international collaboration, but they need to be supported in the initial stages of their transition into the new educational environment and culture.

Despite recognising the need for the higher educational institutions to support the transition of these international students, the transition challenge for postgraduate course-work students still "loom large in omission only" (Stagg & Kimmins, 2014). There is little research into the mechanisms to address the challenges, and to support these students to smoothly transit into the new educational environment. It is less known about these students' goals, motivations, individual hurdles or learning strategies to ensure a successful transition. This lack of knowledge has hindered the provision of effective educational and social support to these students, which is sub-optimal for student attraction, retention, and wellbeing. It has also hindered the provision of subject curriculum that meets their distinct backgrounds and helps develop the required disciplinary expertise.

Most importantly, many university graduates cannot successfully secure jobs that match their studies because of increasing employer expectations that graduates would not only have specialised disciplinary knowledge but also a range of cognitive and interpersonal skills and abilities that are transferable across occupations and industries (Clarke, 2018). Specifically, skills expected of work-ready graduates include those related to communication, teamwork, planning, organising and problem solving (Blaxell & Moore, 2012). Further, the changing nature of technology, work and society requires individuals to be ready for life-long learning, an enduring cyclical activity of the continuous development of knowledge and skills throughout a person's life. Therefore, it is critical for graduates to be highly competent and motivated to engage in ongoing self-directed learning and develop skills for self-regulated learning. This invites teachers to embrace pedagogies that combine social forms of learning with deep metacognitive engagement and self-regulation, such as pedagogies that draw on social constructivist theories of knowledge and learning (Taber, 2020). Therefore, the aim of this practice-based teaching and research project is to embed the self-regulation cycle into learning task design to support the

transition of international postgraduate students into the Australian coursework program.

Background and Motivation for this Study

Course Context

Information Design and Content Management is a compulsory subject for two postgraduate courses offered by the School of Computing and Information Technology at the University of Wollongong: Master of Information Technology and Master of Health Informatics. It is also an elective subject for Master of Public Health and Master of Computer Science. The course handbook describes it as a subject that: "examines the use of information in organisations and how that information is acquired and represented using the latest information modelling techniques". The subject addresses the growing need for a systematic approach to information design, generation, management and document management. It focuses on the use of semantic Web technologies to manage and access information, i.e., metadata modelling, information modelling and information retrieval.

The subject learning outcomes state that: on successful completion of this subject, students will be able to: (1) understand and explain the main information design and content management concepts; (2) describe the organisational and technical issues associated with information design and content management and propose solutions to those issues for specific contexts; (3) identify and select information design and content management technologies appropriate to particular business problems; and (4) use information design and content management technologies to manage, design, or develop web-based solutions.

All these learning outcomes are within the scope of knowledge engineering, which includes technical, scientific, and social aspects of designing, building, maintaining and using artificial intelligence systems. It is the backbone of the semantic Web technology that aims to represent information in a way that is understandable by humans and computers alike (Taye, 2010). A major knowledge engineering project that runs from the start to the end of the semester is designed as a significant learning task for the students to engage in hands-on practice to transfer the theory of knowledge engineering into practice and achieve the subject learning outcomes.

Student Profiles

The subject *Information Design and Content Management* is predominantly taken by international postgraduate coursework IT students. In 2018, when this design-based research study was first conducted, there were 133 students enrolled in the subject, 33% from China, 33% from India. The rest students were from nine countries: Saudi Arabia, Pakistan, Nepal, Malaysia, Indonesia, Thailand, Vietnamese, and Iran. There were only 4 (3%) Australian students. Teaching experience and literature show that international students experience difficulties in understanding lectures, reading and comprehension, and understanding what is expected of them (Lynch, 2015). Many students enrolled in this subject lacked experience in information synthesis and academic writing. Many of them also had part-time jobs while studying; thus, were often under time pressure for assignment completion.

Design Challenges

Selecting an appropriate project task for the international postgraduate IT students to practice knowledge engineering has been a significant challenge. Knowledge modelling, by nature, involves conceptual abstractions. There is also a steep learning curve mastering disciplinary tools, such as the open-source ontology editor Protégé that students need to use for knowledge graph (ontology) development. Creating conceptual abstractions relies on familiarity with the subject domain, including knowledge about the concepts and their relationships. It is challenging for students from diverse cultures, history, traditions, and educational backgrounds to reach a reasonable level of familiarity with any new subject domain in a 13-week semester. The large number of students makes it not feasible to place them in any specific industry setting and create opportunities to familiarise and develop knowledge models for that industry. Therefore, an innovative approach was required to design a suitable knowledge engineering project task for this cohort of students. The idea was to focus on self-regulation and other graduate qualities as a knowledge domain for this engineering project.

Theoretical Framework

Self-regulated Learning and Social Constructivism

Learning depends on a range of factors, i.e., learner's motivation, goal setting, strategic planning, self-regulation, observation and control of own learning behaviour (Zimmerman, 2002). Self-motivation comes from students' beliefs about learning, i.e., self-efficacy, outcome expectations, intrinsic interest/value, and learning goal orientation. A fundamental goal of education is to promote students to use learning strategies effectively, appropriately and independently (Paris et al., 2008). Educational research demonstrates the usefulness of providing metacognitive and social support when teaching students to use effective strategies for reading, writing, mathematics, and other kinds of learning.

Self-regulated learning (SRL) refers to the active, goal-directed self-control of behaviour, motivation, affect and cognition for academic tasks by an individual learner (Pintrich, 1995). It calls for self-generated thoughts, feelings and behaviours that are oriented to goal attainment (Zimmerman, 2002). SRL is an important predictor of student academic success and is essential to the learning process. According to the SRL literature, self-regulatory processes are teachable and can lead to increasing students' motivation and achievement (Muis et al., 2016). Therefore, developing self-regulation is a key function of education as it contributes to developing life-long learning skills.

Vygotsky's sociocultural theory of human cognitive development views social interaction, i.e., discussion, negotiation and sharing among learners, as the cornerstone of knowledge construction (Taber, 2020; Vygotsky, 1978). It allows the learners to engage in the authentic learning process until they fully internalise and master the complex conceptual ideas and take ownership of the knowledge. This theory encourages collaborative learning and group work. It sees learning goals and motivations as both intrinsic, driven by learners and extrinsic, promoted by the knowledge community. It encourages social dialogue between students during which they share, explain and challenge ideas, as such dialogue facilitates their cognitive development. In particular, scaffolding, i.e., discussions about strategies and how to use them, and making the tactics visible, can support learners to develop strategic and independent problem solving skills, and help novices to learn and accomplish the task (Shvarts & Bakker, 2019).

This design-based study aimed to integrate the development of IT postgraduate students' SRL skills into the design of a knowledge engineering project. Social constructivism provided a theoretical foundation for choosing collaborative learning (i.e., group work) and designing diverse forms of scaffolds to address the cognitive challenges of knowledge modelling tasks that students need to complete.

Structure and Function of Self-regulatory Learning Processes

The structure of self-regulatory learning processes is composed of three cyclical phases (Zimmerman, 2002): the forethought phase, the performance phase and the self-reflection phase.

Phase 1. Forethought phase includes the processes and beliefs that occur before learning, i.e., task analysis and self-motivation. Task analysis includes goal setting and strategic planning.

Goal-setting theory considers it necessary to set specific and challenging goals for sustained effort, energy, attention, motivation, and success of a learner (Noe & Winkler, 2012). Strategic planning covers key tactics for achieving goals and identifies a series of desirable attributes for successful goal attainment and reward mechanisms (Zimmerman, 2002). Because students with a well-prepared plan are more productive, informative, and successful in their academic journey than those who do not, developing planning skills is important for students' overall learning success (Chuvgunova & Kostromina 2016).

Phase 2. In performance phase the student implements learning actions (Zimmerman, 2002). A success results in new knowledge or skill, while an incompletely resolved problem becomes a new experience. Learning success is mediated by self-control and self-observation. Self-control refers to the application of specific methods or strategies for regulating one's behaviour that were designed in the planning phase. Self-observation refers to self-recording personal events or self-experimentation to identify the cause of these events.

Phase 3. Self-reflection phase involves the evaluation processes after each learning effort. The learner reflects the experiences acquired in Phase 2, particularly experienced problems. Self-judgment and self-reaction are conducted to generate ideas about how to solve these problems. Self-judgment of goal progress is affected by the value of goal attainment. If students care little about their learning performance, they may not assess their performance or try to improve it. If they doubt their ability, they may judge learning progress as inadequate and be de-motivated to work.

Methods

Learning Task Design for Facilitating Self-Regulation and Collaboration

Three assignments were designed to provide students with the opportunity to learn and develop disciplinary skills, embedding the self-regulation cycle into the task design (Table 1).

Table 1. The schedule of learning tasks that embed self-regulation

Week	Arrangement of learning tasks that imbed social learning and self-regulation	Self-regulation phase
2	Scaffolding activities for Assignment 1 • Forming learning groups in Lab 1. Individual tasks: • Complete the Moodle questionnaire 'Who am I? A self-test'. • Use the structured 'My study plan' on the subject e-learning platform Moodle to set study goals for this semester.	Phase 1
3	Group tasks in Lab 2. • Task 1: Conduct content analysis on the anonymised answers to the study plan by the class to identify the common study goals, challenges and actions to address the challenges. • Task 2: Make a SMART (Specific, Measurable, Achievable, Relevant, and Time-bound) plan for your group's learning journey	Phase 1
7	Scaffolding activities for Assignment 2 • Assignment 2 group progress presentation in Lab 7	Phase 2
8 - 9	Scaffolding activities for Assignment 3 Part 1 • Data analysis: Practice to use Microsoft Excel's advanced functions for data cleaning, basic calculation, statistical analysis and generate visualisation graph	Phase 2
12	Scaffolding activities for Assignment 3, Part 2 • Insert instances into the ontology • Repeat 'Who am I? A self-test" in Lab 12.	Phase 3

Assignment 1 is a 3,000-word group report entitled *Design and manage learning journey for transition and success at UOW*. It required the students to generate content for the information modelling task in Assignment 2, ontology building. It corresponded to the planning stage of self-regulated learning (Table 1 Phase 1). The design goal is to enable collaborative learning, share perspectives, observe, and compare goals and learning strategies, and to improve learning strategy design through brainstorming. Each group included 4-5 students and was formed voluntarily. Instructions were given for the learners to reflect on their own learning experiences, and literature to identify the enablers and barriers for successful learning outcomes, design strategies to maximise enablers and overcome barriers. Labs 1 and 3 were designed to scaffold the task of Assignment 1. In Lab 1, a self-administered questionnaire survey 'Who am I, a self-test' was conducted for students to develop own study goal and study plan. In Lab 3, the students worked in groups to synthesise the goals developed in Lab 1 into generic group SMART goals, i.e., Specific, Measurable, Realistic and Time-bound.

Assignment 2 was the key learning task to develop the core disciplinary skills of knowledge modelling. It requested each group to represent the study plan developed in Assignment 1 in Web ontology. To ensure that low performance in Assignment 1 does not affect negatively on Assignment 2, Exemplar Assignment 1 solutions were sourced from four student groups who gave consent and shared with the whole class. It enabled the students to learn from the other's better practice to incorporate the key concepts and relationships that they

missed in Assignment 1. This facilitated refinement of goals and study plan, and their transformation into the abstract concepts and relationships in the knowledge model. Again, drawing on the principles of social constructivism, group work was embedded in the design of the learning task. Labs 5 and 6 were designed for students to practice and familiarise themselves with the software for editing the ontology. In Lab 7, each student group gave a 10-minute oral project presentation to the class. The report included their method of ontology development, project task allocation, team communication, and the current product. These tasks provided them with the opportunity of monitoring and evaluation for SRL and scaffolding and collaboration.

The learning goal of Assignment 3 was to practice entering individual cases into the ontology developed in Assignment to avoid the potential differences among the students at the start point of the task due to different levels of performance in Assignment 2, a standard ontology was provided. The assignment provides the opportunity for a student to reflect on their own learning practice so as to "instances" for each concept in the ontology. The questionnaire survey "Who am I, a self-test" was repeated in Week 12 lab to re-assess the students' perceptions about themselves at the conclusion of the semester.

Results and Discussion

The results suggested that the suite of purposefully designed, practice-based assessment tasks and scaffolded activities supported the international postgraduate coursework IT students' transition and developing of life-long learning skills. The designed scaffolding underpinned by the principles of social constructivism helped to maximise students' engagement in, and benefits of, collaboration, teamwork, and peer support. The interviews with students suggested that they welcomed the project and appreciated the professional development opportunity. They enjoyed experiential learning, i.e., embedding learning plan, execution, and evaluation with completing assignments. Goal setting was seen as most useful to remind them to align their activities with learning goals. The success and lessons learned will be further elaborated during the presentation.

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