Focusing on learning through constructive alignment with task-oriented portfolio assessment

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Abstract

Approaches to learning have been shown to have a significant impact on student success in technical units. This paper reports on an action research study that applied the principles of constructive alignment to improve student learning outcomes in programming units. The proposed model uses frequent formative feedback to engage students with unit material, and encourage them to adopt deep approaches to learning. blueOur results provide a set of guiding principles and a structured teaching approach that focuses students on meeting unit learning objectives, the goal of constructive alignment. The results are demonstrated via descriptions of the resulting teaching and learning environment, student results, and staff and student reflections. Assessment; Formative Feedback; Portfolio Assessment; Constructive Alignment

1 Introduction

Biggs (1996) work on constructive alignment placed this initiative within the context of a complex system involving, at the classroom level, teachers, students, the teaching context, assessment, learning activities, and unit[1] learning outcomes. While interactions between all components of this system determine the overall learning achieved, the system is driven by assessment. Biggs work reported a change in system bluedynamics with a shift to portfolio assessment, from which the principles of constructive alignment arose.

Constructive alignment represents the combination of constructivist learning theories and aligned curriculum. Constructivism is used as a theory of knowledge as it focuses on the student's active role in constructing their own knowledge. This is combined with aligned curriculum to focus student activity on unit learning outcomes, giving rise to the motto: "it's what the student does that counts". When constructive alignment is blueachieved, Biggs (2012) reports changed system bluedynamics with clear and consistent *alignment* of the sytem on learning outcomes resulting in what he calls a "web of consistency" that optimises the likelihood of students engaging appropriately with learning activities and assessment tasks. By this he means that the assessment tasks undertaken by students consistently align with the learning materials and learning outcomes.

Within higher education, constructive alignment has been shown to have positively influenced teaching and learning at a unit and institutional level (Biggs, 2014). However, reported applications of constructive alignment tend to focus predominantly on curriculum alignment with little attention paid to engaging constructivist learning theories (Jervis and Jervis, 2005). Most papers describing applications of constructive alignment focus on staff aligning teaching and

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[1]blueFor this work we will use the term *unit* to refer to a unit of study within a degree programme.

learning activities with learning outcomes (Cain, 2013a) and do not report the same change in system dynamic reported by Biggs (1996). blueThis suggests that additional there were additional principles at play in the environment reported by Biggs.

This paper reports results from an action research study that aimed to improve student learning outcomes in introductory programming units through constructive alignment. The work aimed to achieve changes in system dynamics by adopting an approach based on Biggs (1996) work on constructive alignment. Guiding principles discovered through this application are presented along with a teaching approach and model for constructive alignment using a task-oriented approach to portfolio assessment. The resulting teaching and learning environment has seen improved student learning outcomes, observed changes in system dynamics, and positive student feedback.

2 Related Literature

2.1 Constructivist Learning Theories

Traditional learning theories and constructivist theories differ in their view of how knowledge is constructed. These differences result in different teaching environments, and different approaches to assessment. Traditional epistemologies view knowledge as being a reflection of reality, with resulting teaching systems involving classes in which the educator present knowledge to students; the lecture being a typical example. While there is a range of different views on constructivism, all forms of constructivism view knowledge as being constructed in the mind of the learner (Biggs, 1996; Bodner, Klobuchar, and Geelan, 2001; Jonassen, 1991; Steffe and Gale, 1995; Vrasidas, 2000). By implication, this challenges the view that knowledge can be transferred intact from the mind of the educator to the mind of the learner. As a result, the role of the educator changes from someone who "teaches" to someone who facilitates learning (Bodner, Klobuchar, and Geelan, 2001).

blueConstructivist epistemology views knowledge as a human construction. For education, this has the implication that teaching should be centred upon helping develop the learner to think and act like an expert (Jonassen, 1991; Vrasidas, 2000). Adopting this epistemology requires that assessment involves comparing the structure of the learner's knowledge with that of an expert. This view allows errors in understanding to be used diagnostically as an opportunity for further learning (Murphy, 1997).

Constructivism has received some strong criticisms when taken to an unproductive extreme (Anderson, Reder, and Simon, 1998; Kirschner, Sweller, and Clark, 2006). In these more radical views of constructivism, knowledge is seen as *never* being transferred intact (Bodner, Klobuchar, and Geelan, 2001). This view often leads to minimal instruction or guidance. Anderson, Reder, and Simon (1998) and Kirschner, Sweller, and Clark (2006) argued that free exploration is likely to generate a heavy workloads and detrimentally affect learning, while also indicating that there is significant evidence of the benefits for guided instruction from cognitive psychology.

blueConstructive alignment is based upon constructivism as its central guiding philosophy. Therefore, to successfully implement constructive alignment, educators must adopt key constructivist learning theories as their theory of teaching and learning. This is likely to require changes in both teaching delivery and assessment approach.

2.2 Formative Feedback

The central role of assessment in defining what the student does is supported by Ramsden (1992), who stated that "from our students' point of view, assessment always defines the actual curriculum", and further supported by Biggs and Tang (2007) who indicated that "students learn what they *think* they will be tested on." Gibbs and Simpson (2004) work on effective assessment discussed the dominant influence of assessment in determining what students focus on. blueConstructive alignment aims to utilise this focus as a means of directing student behaviour. In discussing the use of constructive alignment to engage students in appropriate learning, Biggs (2012) described portfolio assessment as achieving a "web of consistency" through which educa-

tors can optimise the likelihood of students *engaging appropriately* with learning activities and assessment tasks. This highlights the impact that a changed assessment strategy can have on the overall teaching dynamics.

In general, assessment can be seen as serving one of two purposes: supporting learning via *formative feedback* or evaluating outcomes with *summative grading*. Formative feedback has been widely reporting as playing an important role in education, with the provision of helpful feedback being the most clear indicator between the best and worst courses (Ramsden, 1991). blueThis is further supported by reviews of formative feedback by Wiliam (2011) which showed that substantial learning gains can be achieved by innovations designed to strengthen formative feedback.

If assessment is to assist learning, then formative feedback is critical and must be at the heart of the process (Brown, 2004). Spelt et al. (2014) noted that students valued individual feedback over peer feedback or self assessment, indicating the value students put on formative feedback as input into their studies.

Coursework assignments are often planned to play a formative role during unit delivery, however, bluethere is some evidence that bluemarks can detract from the formative nature of assessment, with students pay more careful attention to feedback when there are no associated marks (Black and Wiliam, 1998). This is further supported by the work of Skinner (2014) which indicated that feedback on graded tasks was not seen as formative, but rather as providing justification for the marks received. blueThis indicates a potential for marks to reduce the formative nature of assessment, blueand provides an opportunity to refocus system dynamics by removing marks from coursework assignments. We note that there may be differences relating to cultural or other factors that are not highlighted in these studies.

blueGibbs and Simpson (2004) summarised the requirements for assessment to assists student learning as involving:

- Assessment tasks that are aligned with intended learning outcomes, and provide students with sufficient work to ensure they engage appropriately with the required learning.
- Feedback is constructive in nature, providing information that students will be able to use to develop their understanding of associated concepts.
- Students are required to utilise the feedback, using it to inform future actions.

2.3 Views on Student Motivation

blueEducational initiatives that look to alter the dynamics of the teaching and learning system need to take into consideration how teach staff percieve student motivation as different perceptions are likely to result in different assessment strategies. McGregor (1960) provides some interesting insights in terms of motivational strategies related to business, and this work can provide some insight into strategies that could be applied in an educational context (Markwell, 2004). McGregor (1960) examined personnel management and defined two categories of manager's perceptions of their employees: named "Theory X" and blue"Theory Y".

- Traditional businesses were seen to use coercion or persuasion as a strategy to motivate employees to achieve required levels of productivity. These strategies are used when managers adopt the view that employees *do not want to work* and *cannot be trusted*, McGregor (1960) named this understanding of human motivation as Theory X.
- In contrast, Theory Y assumes that, given the right conditions, *people want to work*, that they *can be trusted* and will do their best work when they are.

While the work was originally applied in a business context, Markwell (2004) has applied these views to educational settings. blueIn an educational setting, Theory X is associated with more traditional approaches to education, where the teacher takes on the role of distributing knowledge: the classic "sage on the stage" approach to teaching. Theory X can be categorised as:

- Being dominated by a negative view of students and their motivation.
- Seeing staff as central to the distribution of knowledge.
- Believing that students must be coerced into learning.

In contrast, Theory Y views students as being naturally inquisitive, willing to learning, and capable of engaging appropriately with learning activities where the environment is setup to support them in these tasks. This aligns well with the constructivist view of education, and changes the role of the teacher to that of a facilitator of learning: a *guide by the side*.

2.4 Related Applications of Constructive Alignment

blueConstructive Alignment has been applied across a broad range of fields (Cain, 2013a; Biggs, 2014). Related work by Gaspar and Langevin (2012) and Thota and Whitfield (2010) have reported on the use of constructive alignment for teaching introductory programming. Thota and Whitfield (2010) described the alignment between assessment and unit learning outcomes for an introductory unit on object oriented programming. Their assessment strategy involved a group project, programming assignments, quizzes, and an examination. Gaspar and Langevin (2012) did not discuss their application of constructive alignment, but outlined the importance of adopting these principles in teaching introductory programming.

blueThese approaches are consistent with the general applications of constructive alignment (Cain, 2013a). They remain primarily teacher-focused with little change to assessment beyond teaching staff aligning assessments to learning outcomes. While these approaches do meet the basics of constructive alignment, there is some discussion on constructive learning theories, but few opportunities for students to learn from their mistakes, and no indication of a fundamental change in system dynamics.

3 Research Method and Context

blueThe key research questions we wanted to answer were:

1. Can we apply Bigg's constructive alignment concept to the teaching of programming units with the use of portfolio assessment in order to recreate the system level changes observed by Biggs (1996)?
2. Can we expand Bigg's approach to the teaching of large first year undergraduate units?
3. Are there other principles associated with the approach that help achieve any changed system dynamics? We note that other approaches to constructive alignment have not generally reported a change in system dynamic

To answer these research questions we used a practical action research approach (Creswell, 2011) based on Mills (2010) *dialectic action research spiral*, that aimed to use ideas from Biggs (1996) to achieve a system that focuses students on learning. The action research approach suited the practical and applied nature of the research, allowing the focus to be on student learning while also developing an improved understanding of the principles of constructive alignment. This approach involved four steps as illustrated in Figure 1: (1) identify an area of focus, (2) collect data, (3) analyse and interpret the data, and (4) develop an Action Plan. blueFeeding into these research activities were a number of teaching and learning activities, including refining the model of teaching, defining learning outcomes and assessment criteria, developing teaching and learning activities, delivering the unit, providing feedback, and assessing portfolios. Discussion of the research activities follows, with the teaching and learning activities discussed in the following sections.

Each iteration had a specific action plan based upon the research goals and findings of earlier iterations. These plans involved refinements to the model, and provided each iteration with a specific focus. The focus and action plan were used to adjust the teaching and learning approach documented in the unit outline, which consisted of the units learning outcomes and assessment

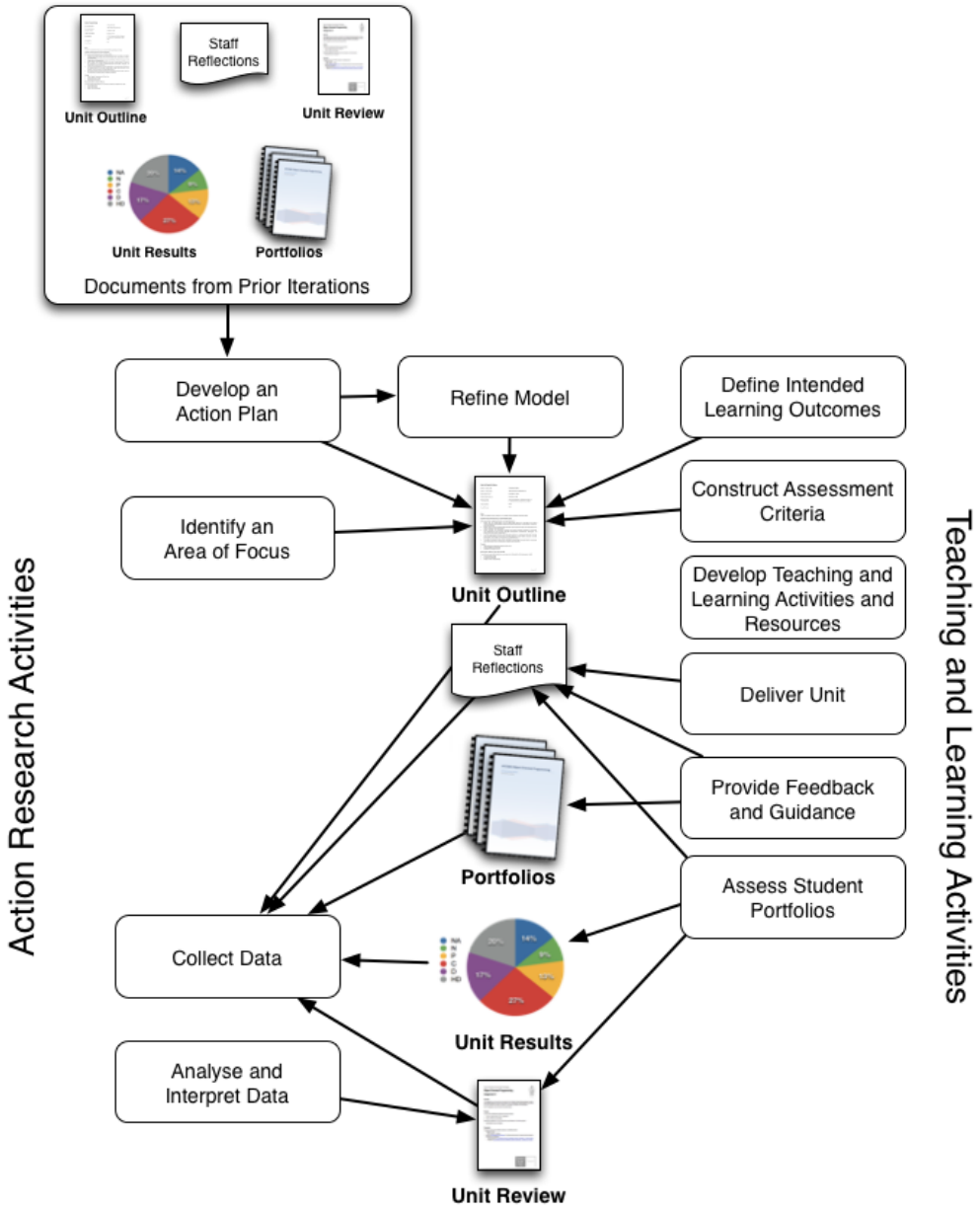

Figure 1: Relationship between Mills' Dialectic Action Research Spiral (Mills, 2010) and teaching and learning activities.

criteria. During the execution of that action plan, data was collected from staff reflections, student portfolios, unit results, and the final unit review documents. These documents were collected from several units bluetaught across a range of degree programmes, with the main focus on Introduction to Programming and Object Oriented Programming, but with additional input from more advanced technical units including Artificial Intelligence for Games, Games Programming, and Concurrent Programming units. Data collected was analysed and interpreted, with results feeding back into the unit review and informing the plan for subsequent iterations. This paper provides an overall summary of the model and principles that arose from this process. Specific details of the various iterations is reported in Cain (2013a,b) and Cain and Babar (2016), with relevant details presented in the following sections.

blueThe main context for this work was the Introduction to Programming from Swinburne University of Technology. This is a large first year unit with several hundred student enrolments each semester. The unit is offered to a broad range of students studying information technology, engineering, science and game development. In general, students have no prior programming experience and undertake this unit in their first semester. The objective of the unit is to introduce students to procedural programming concepts. Introduction to programming has the following intended learning outcomes:

1. blueApply code reading and debugging techniques to analyze, interpret, and describe the purpose of program code, and locate within this code errors in syntax, logic, style and/or good practice.
2. blueDescribe the principles of structured programming, and relate these to the syntactical elements of the programming language used and the way programs are developed.
3. blueConstruct small programs, using the programming languages covered, that include the use of arrays, functions and procedures, parameter passing with call by value and call by reference, custom data types, and pointers.
4. blueUse modular and functional decomposition to break problems down functionally, represent the resulting structures diagrammatically, and implement these structures in code as functions and procedures.

Prior to this work, the units used in this research were assessed using assignments and a final examination. While these assessment tasks were aligned to learning outcomes, this approach to adopting constructive alignment did not result in a change of dynamic to focus on learning. Specifically:

1. This approach was predominantly teacher-centered, and did not easily incorporate aspects from constructivist learning theories.

2. Summative assessment during the semester was not being used effectively to focus students on learning.

3. Marks for assignments were provided more to motivate students to perform these tasks than as accurate measures of final summative achievement.

4. Assignment marks were final, providing little incentive for students to incorporate feedback, and reflect on their learning.

4 Results

4.1 Guiding Principles

blueIn implementing Biggs (1996) approach to constructive alignment, our resulting model was influenced by the following principles. These principles incorporate Biggs' focus on constructivist epistemology and aligned curriculum, but extends this with an emphasis on formative feedback and reflective practice. These principles were identified by reflection through the action research method as playing a significant role in shaping the learning environment. The principles are outlined below, with details of their application described in the following sections.

These principles aim to focus the teaching and learning system on learning. Principle 1 required the adoption of constructivist learning theories as theory-in-use. Principle 2 aimed

to refocus assessment through effective use of formative feedback, allowing staff to work with students to help them achieve the required knowledge. Achieving this change in required a positive view of student motivation, Principle 3, with educators focusing on constructing a supportive learning environment. Reflective practice, Principle 4, aimed to ensure that the system evolved through incremental changes to better support students learning outcomes. Individually each of these principles has value, however when taken as a group these principles form a cohesive focus for the application of constructive alignment that is likely to result in a change in system dynamics.

The principles identified and used to guide the application of task-oriented portfolio assessment included:

(P1) Recognise that students construct knowledge in response to activity.

(P2) Use assessment to drive learning.

(P3) Trust and empower students to manage their own learning.

(P4) Embed reflective practice in all aspects.

bluePrinciple 1 was adopted as a key pilar of constructive alignment and influenced both the teaching method and assessment approach. Early iterations of this research project looked to apply Biggs (1996) model of constructive alignment with portfolio assessment by asking students to prepare a portfolio that demonstrated they had achieved unit learning outcomes. This was based upon more radical views of constructivist epistemology, and encountered issues with student learning (Cain, 2014). Later iterations adjusted the application of constructivism to recognise the value of guided instruction blueand provided structure and flexibility by focusing student work during the unit on smaller tasks aligned to learning outcomes. These changes resulted in improved student work, with incremental improvements in guidance seeing improved results across later iterations.

bluePrinciple 2 includes the ideas of aligned curriculum from constructive alignment, but extends this with the notion of directing learning though formative feedback during the teaching period. This was present across all iterations, with students receiving feedback on their work as they progressed through the unit. In reflecting on this across the project, this notion of using formative feedback was critical in changing the system dynamic. By removing marks from the tasks, staff and students were working together to help students achieve learning outcomes. This enabled assessment to actively support learning, with staff being able to provide .

- blueStaff noted students paying more attention to feedback, and making use of feedback provided to improve their understanding and adjust work for their portfolios. Most students actively engage with the formative process, despite there being no marks attached to unit tasks.
- Student comments on the best aspects of the unit specifically noted feedback in 6 cases, with further 39 indicating the tasks and using these to develop understanding without needing marks. The following small selection of quotes highlight the changed nature of assessment in the unit, and the impact it had on these students. These comments support staff reflections in relation to the changed dynamics for assessment, with assessment helping focus students on learning.

  > "The whole concept of progressive learning and feedback has made it much easier to focus on achieving the grade that I wish, something a lot harder to do when assessments are a one-shot-only thing. Being able to try and try again to get a program to do what it is meant to do for a passing grade means that the later tasks were considerably easier to tackle because I knew I had effectively mastered the previous knowledge."
  >
  > "... The ability to return to harder assessments when we have more time, or when we learn a bit more is much more motivating, and a much more accurate

> assessment of our knowledge and skill. It makes [other classes] seem silly in that it seems like the unit is against you, and they want to take marks from you where ever possible, this unit was the opposite, it feels like everyone involved is a team, rather than competitors or barriers.. . . "
>
> ". . . everyone supporting each other to improve instead of a system where students compete for grades. Students can aim for the grade they want . . . "

blueIn reflecting on the system, the importance of a positive view of student motivation was identified as a key factor, as expressed in Principle 3. Standard assessment approaches are typically informed by a Theory X view of student motivation, allowing students flexibility and the ability to own the learning experience required a shift to a more positive Theory-Y view of their motivation. The student appreciation of this change is aptly captured in the following comments about the best aspects of the unit.

> blue"The RESPECT shown to students, which permeates through all aspects of the unit's design. Students are afforded a tonne of opportunities for help, the grading system is insanely fair, Doubtfire is a revelation, CodeCasts help a tonne, [staff are] thoroughly engaging, clear and inspiring, as are the team of talented tutors who have made all the difference. I have studied various subjects at [other universities], and I can safely say I have NEVER encountered a class this well organised and aligned to the needs of the modern student. As a [mature age student] who works and has never coded before, I was exceptionally daunted coming into this class. The combination of convenor, faculty and course design has directly helped me achieve results I had never thought possible. I feel confident and hungry to learn more. 11/10 guys."
>
> blue"The system in which students "choose" their grade and then do a set amount of tasks to achieve it. Knowing exactly what you need to do from the very start allows you to pace yourself appropriately even if you fall behind. The custom program for the HD task is also a lot of fun and I hope the unit remains like this."

The importance of the Theory Y view of motivation was observed across a number of events. Initial iterations were largely guided by this positive view of student motivation. In some of the later iterations student progress with assigned tasks was seen as lacking, and punitive means of motivation were adopted requiring students to complete tasks by intermediate dates, which resulted in a significant increase in the occurrence of plagiarism. Subsequently reviews of the associated tasks, with a more positive view of student motivation, identified that the required learning and workload across these tasks was likely to be much greater than initially anticipated. This provided an alternative change, with tasks being adjusted to better support student progress without requiring punitive systems to be put in place.

In addition to staff reflecting on teaching, bluePrinciple 4 aimed for students to reflect on their learning. Most reported approaches to constructive alignment require that *staff* align assessment and teaching and learning activities with learning outcomes. However, given the student's central role in constructing their own knowledge, they are best placed to determine how activities helped them achieve learning outcomes. Requiring students, as well as staff, to perform this alignment has many potential benefits. Students undertaking of these units will graduate and move into professional practice. Engaging them with reflective practice throughout their education will help ensure they are adequately equipped for lifelong learning blue(Field, 2006). This reflective process should be built into the summative assessment, requiring students to reflect upon the tasks they have performed and how they related to unit learning outcomes. These reflections can then feed into the staff reflections allowing staff to better understand how the planned teaching and learning activities were received by students.

Across the research project, unit results were seen to improve in all units. For example, pass rates in one unit prior to switching were historically in the range of 50% to 55%, with the new approach this unit has consistently achieved pass rates between 63% and 78%. Staff reflections also note, that along with the improved pass rates, the quality of work presented in student portfolios also improved.

Student feedback has been generally positive across the units involved in this research. Student feedback for the unit has rated it highly in terms of student satisfaction. For the introductory programming unit, the student satisfaction received bluea mean score of 8.6, out of 10, for the question "Overall I was satisfied with the teaching of this unit.", based on responses from 350 of the 539 students that semester. This compares favourably with the faculty mean result of 7.5 and the university mean of 7.6. The unit also received positive rating for clarity of assessment, with a mean of 8.8 compared to the university and faculty means of 7.7.

The clarity of the assessment criteria, and grade requirements was another common theme amongst the comments related to the best aspect of the unit, being specifically mentioned in 16 comments. These comments indicated that the clearly distinct requirements for each grade were also understood by students, and were used to help guide their activity during the teaching period.

> "How well-informed we were. Nothing was unexpected or hidden. All the criteria, the learning material and the expectations were layer out clearly to us from the start and it made it so much easier knowing exactly what you had to do to achieve at a certain level!"

> "Very clear and upfront requirements so I know exactly what needs to be done and when."

Further analysis and discussion of system level changes are presented in (Cain, 2013a,b; Cain and Babar, 2016).

4.2 A Model for Task-Oriented Portfolio Assessment

Figure 2 provides an overview of the Task-Oriented Portfolio assessment approach to constructive alignment developed as a result of this work. This process is based upon the model presented by Cain and Woodward (2012), together with the guiding principles and results from this work.

4.2.1 Assessment Approach

Using assessment to drive student behaviour is one of the key principles adopted in this work. blueWith assessment as the driver of the system, the initial focus for the teaching initiative was to transform assessment to utilise formative feedback during the teaching period. One way to address the issues related to summative assessment during the teaching period could be to abandon coursework assignments, and delay final summative assessment to an examination worth 100%. This would allow feedback during the teaching period to be formative, though this does not recognise the importance of coursework assignments which tend to be more authentic in nature. The arguments for maintaining coursework assignments included:

- Coursework assignments have been shown to help improve overall student grades in units with both exams and assignments (Chansarkar and Raut-Roy, 1987; Gibbs and Lucas, 1997).
- Students indicate that coursework tasks enable them to better demonstrate their abilities, while also being more flexible in relation to time management (Kniveton, 1996).
- Coursework assignments have been shown to be at least as valid a form of assessment as examinations:
  - Exams have been shown to be a poor predictor of future performance (Baird, 1985; Gibbs and Simpson, 2004).
  - Coursework assignments are better predictors of long term learning than exam results (Conway, Cohen, and Stanhope, 1992).
  - Students have been shown to adopt surface approaches to learning when preparing for exams (Marton and Säljö, 1976; Tang et al., 1999).

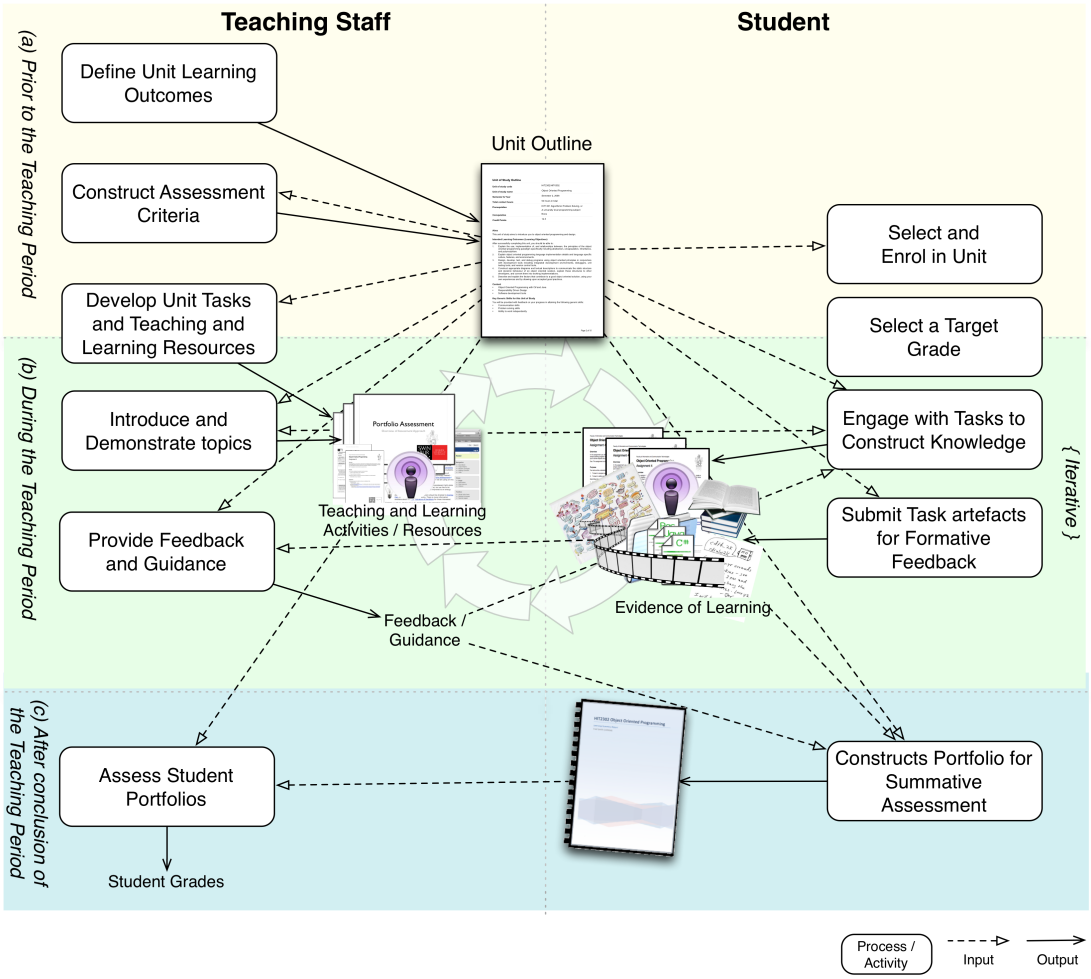

Figure 2: Overview of the model of portfolio enabled constructive alignment.

– Learning is deeper in assignment-based units, when compared to exam-based units (Tynjala, 1998; Gibbs and Simpson, 2004).

The challenge, therefore, was to define an assessment approach that enabled students to construct their knowledge, uses coursework assignments in a formative manner, while also having each student's grade determined after the end of the teaching period.

Constructive alignment evolved out of the decision to use portfolio assessment, and Biggs (1996) advocated strongly for the use of an assessment portfolio as the assessment strategy in adopting the principles of constructive alignment. With this approach, students prepare a collection of work to demonstrate they have met unit learning outcomes. In relation to the guiding principles, portfolio assessment aligns well with all four principles as outlined below.

- The portfolio consists of a collection of work the student feels demonstrates the depth of their knowledge. (P1)
- blueThe portfolio can be used as a mechanism to perform summative assessment at the end of the teaching period, thereby focusing staff and students on *formative feedback* during the teaching period. (P2)
- Summative coursework assignments are replaced with teaching and learning tasks that aim to support learning without the need for summative marks. (P3)
- Frequent feedback, and reflective components in a portfolio encourage students to engage in reflective practice. (P4)

Given its role in the formation of constructive alignment, and its clear alignment with the principles from Section 4.1, this work advocates for the use of portfolio assessment as the assessment strategy. The flexibility of the portfolio approach enables this to incorporate a range of tasks, including group and project work, scaffolded tasks, and examinations where appropriate, while allowing the overall grade to be determined as a holistic assessment of the outcomes demonstrated across all of the work included by the student.

4.2.2 Unit Delivery Approach

Coupled with the assessment strategy is the approach to unit delivery, which determines how staff engage students with teaching and learning activities. This section demonstrates how the principles from Section 4.1 were applied to the units involved in this work.

The shift in teaching philosophy to incorporate constructivist learning bluetheories required changes to the traditional approach taken in lecture classes. Instead of being viewed as the primary means for providing students with *content*, the role of these classes changed to one aimed at inspiring and motivating students to engage in the associated learning tasks. To blueachieve this, the strategy aimed to use short presentations accompanied by interactive demonstrations. Similar approaches have been found to be an effective means of engaging students by Gaspar and Langevin (2007) and Rubin (2013), and help to implement the constructivist approaches to teaching introductory programming discussed by Ben-Ari (2001) and Van Gorp and Grissom (2001). For introductory programming, these interactive demonstrations involved creating programs with the students, with the goal of illustrating how the concepts discussed in the presentation are applied. blueExample programs typically included small interactive games, thereby helping students to link programming structures with visual changes in the program's output and behaviour.

Changing lecture classes in this manner helped address the following principles from Section 4.1:

- Interactive demonstrations and focused presentations aim to provide guidance rather than present knowledge. (P1)
- Presentations and demonstrations aim to inspire and motivate students to engage in the tasks that form the basis of the formative feedback cycles. (P2)
- Moving *content* from the lectures requires a positive view of student motivation. (P3)

4.2.3 Structure Graded Tasks to Guide Student Activity

To help guide students to develop appropriate depths of understanding in these technical units, the strategy involved organising teaching and learning activities across a number of tasks. These tasks replace *all* coursework learning and assessment items, with each unit having many small tasks to guide student learning to enable frequent formative feedback.

Unit tasks were structured around course grade outcomes, with higher grade tasks requiring the demonstration of greater depth of understanding. These included:

Pass tasks designed to scaffold student learning, providing guidance on how to approach problems presented with the aim of building core competencies. These tasks covered all learning outcomes, but only demonstrated a minimal acceptable standard of understanding.

Credit tasks built upon the pass tasks to demonstrate a greater depth of understanding. These tasks had less guidance and focused on communicating the students understanding, or demonstrating use of desired knowledge that went beyond the minimal pass standard for the unit.

Distinction tasks extended students to apply what they have learnt in a context of the students choosing. By building on the credit tasks, these tasks allowed students to demonstrate their individual creativity after having already demonstrated appropriate use of the core and desired knowledge for the unit.

High Distinction tasks further extend students, asking them to move beyond what has been covered in the unit. These tasks involved engagement with research, either in a small project or with demonstrations of this advanced knowledge being applied in a practical context.

Teaching staff planned these tasks to enable students to develop appropriate understanding of unit concepts and to create work that demonstrated this understanding. The design of these tasks aligned with unit learning outcomes, to ensure that students have appropriate material to present in their portfolio.

blueAs an example of how this can be applied, in the introductory programming unit the Pass Tasks involved creating small programs to explore the application of different programming concepts, and lead up to the development of a small program that implemented a simple data entry system involving the use of arrays, custom data types, function and procedures, control flow statements, etc. Running parallel with this were Credit Tasks that had less guidance and had students work through the implementation of a small game, similar to the lecture demonstrations, as well as documenting their understanding using concept maps or textual descriptions. Distinction Tasks incuded some challenge programs, such as implementing the Game of Life and a Mandelbrot viewer, but were mostly centred on the design and development of a program of the students invention. This *custom program* required students to apply what they had learnt, and needed to demonstrate effective use of concepts covered. The High Distinction Tasks asked students to demonstrate exception quality in their custom programs, and provided them with some guidance on how to conduct and write up a small research project associated with programming.

Tutorial classes also changed focus from content delivery, to one of helping students complete tasks and develop the associated understanding. These classes were used to interact with students and to engage each student in the formative feedback process. Once again, the emphasis was on guidance rather than presentation of knowledge.

Basing student activity on structured tasks helps address the principles as indicated in the following list.

- Activities help students develop understanding of the concepts being covered. (P1)
- Tasks provide students with material that fed into the formative feedback process. (P2)
- Using this approach students take a greater responsibility for their own learning. (P3)
- A reflective task can be incorporated where students reflect on their learning and indicate how tasks, from their perspective, align with unit learning outcomes. (P4)

4.2.4 Task-Oriented Portfolio Assessment

Within the model, blueteaching staff are responsible for setting unit learning outcomes and assessment criteria. Unit tasks and teaching and learning resources are developed or sourced to support students in achieving these outcomes. During the teaching period, staff work iteratively with students to deliver the unit by introducing and demonstrating topics and concepts, as well as providing feedback and guidance to students as they attempt to apply these concepts to unit tasks. Staff activities feed into student processes whereby they engage with unit tasks to construct knowledge, resulting in artefacts that can be submitted for formative feedback. At the end of the teaching period, students use the artefacts they have created to construct a portfolio that demonstrates they have met all unit learning outcomes. The portfolio is then assessed by staff against the assessment criteria defined to determine final student grades.

The concept of learning outcomes is central to constructive alignment, but takes on additional meaning with portfolio enabled constructive alignment as these outcomes set the requirements for student portfolios. Given student's focus on assessment, this strategy helps to ensure that students and staff are both working toward the same objective. Biggs and Tang (2007) and Cain and Woodward (2012) describe methods for defining unit learning outcomes based upon the SOLO taxonomy. These methods involve selecting verbs at appropriate cognitive levels, so as to ensure that students must engage cognitive activities that are likely to elicit the required learning.

Final assessment of student portfolios involved the use of criterion-referenced assessment. The criteria indicated how portfolios can demonstrate the learning outcomes to different grade standards (Cain, 2013b). Grade outcomes can be tied back to unit tasks, with each grade requiring students to have demonstrated the ability to complete all tasks associated with that grade. Thereby, students attaining a passing grade have demonstrated the ability to complete tasks that represent the minimal passing standard. Students achieving a credit grade, has demonstrated further knowledge having completed the pass and credit tasks, while Distinction and High Distinction grades were awarded for students demonstrating the ability to apply their learning to projects of their own creation, and for demonstrating the ability to research and extend their understanding beyond the unit context. This approach to the assessment criteria aims to ensure clarity with distinct requirements for each grade.

The changed role of assessment meant that students were encouraged and rewarded for engaging with formative feedback. In completing unit tasks, students developed artefacts that were submitted to staff for feedback. Staff examined the work and tailored feedback to best assist each student based upon the understanding demonstrated. Within the formative feedback process, staff indicated which tasks needed to be fixed and resubmitted by students, thereby requiring students to address feedback provided. Students adjusted their work to correct issues or misunderstandings, and resubmitted it for reassessment. This process continued until the work achieved the required standard, at which point it was marked off as being complete. This process can be supported with appropriate software to help students track their progress throughout the unit (Woodward et al., 2013).

With unit tasks targeted at different grade levels, students can select the grade they aimed to achieve. This tailored the list of tasks to their personal study aspirations, and helped students take ownership of their own learning. It also ensured that tasks aimed at higher grade levels could be appropriately challenging, without the fear of negatively impacting students who are not aiming for this outcome. While students selected a grade at the start of a unit, this could be changed at any time allowing teaching staff to encourage students who are progressing well to aim for higher grades.

The ability for students to select a target grade was found to positively impact on task design. To pass the unit students needed to complete the Pass tasks, with tasks for Credit and higher grades not directly contributing to the requirements to "pass". This enabled the Pass tasks to focus on *requiring* students to demonstrate *all* learning outcomes. Where a student was unable to complete the Pass tasks, this demonstrated a significant gap in their knowledge. Similarly, Credit and higher grade tasks could focus on more challenging work as students would not need to attempt these if they were struggling to achieve the pass standard. This helped ensure students had achieved all learning outcomes, rather than just having accumulated sufficient marks without

necessarily demonstrating complete coverage.

This approach to unit delivery addressed the principles as indicated in the following list:

- Staff work to guide student learning, rather than aiming to transmit knowledge. (P1)
- Formative feedback cycles enable assessment to drive student behaviour. (P2)
- Students take responsibility for their learning, being able to aspire to achieve a given grade, and apply their own imagination and interests to achieve higher grades. (P3)
- Student engagement with unit tasks and associated submissions can be used to judge the effectiveness of tasks and activities in engaging students with the learning outcomes. (P4)

For the summative assessment, students construct a portfolio that consists of tasks they have completed along with a *Learning Summary Report* (LSR). The LSR outlines the grade the student is applying for, together with a justification for this grade based upon the work presented and the unit's assessment criteria. This required students to reflect upon their learning and to align the tasks they have completed with the unit learning outcomes. The resulting portfolios were submitted to staff for summative grading.

Staff assess the submitted portfolios by reviewing the student's LSR, and verifying that the work presented meets the standard expressed in the unit's assessment criteria. This assessment is guided by the grade the student applied for in the LSR, and could take advantage of the formative feedback process by reviewing the status of the students tasks. Where the relevant tasks had been marked as complete, staff could be certain that the work had already been checked to be of the required standard.

The assessment approach addressed the principles as indicated in the following list:

- Students are actively encouraged to include pieces that demonstrate their learning, aligning tasks they complete with unit learning outcomes. (P1)
- Feedback from the formative feedback process can be acted upon by students, with improved versions of earlier work being included as pieces in their final portfolios. (P2)
- Students are encouraged to reflect on their learning experience, and to document these reflections in the Learning Summary Report. (P4)

5 Discussion

blueIn applying constructive alignment, one of the key goals of this work was to achieve system level changes similar to those reported by Biggs (1996). Staff reflections observed changes in the overall teaching and learning environment that indicate positive changes were achieved. In proposing constructive alignment, Biggs focused on principles associated with constructive learning theories and aligned curriculum. Subsequent applications have focused on staff aligning learning with outcomes, but have not significantly altered assessment nor reported changes in system dynamics. We propose that a greater focus on the use of assessment to drive student learning is required in addition to the focus on constructivist learning theories and aligned curriculum to order to achieve changes in system dynamic similar to those reported by Biggs.

The model presented in this work aimed to enhance learning outcomes through the use of blueconstructive alignment with frequent formative feedback and delayed summative grading. blueRemoving marks from unit tasks enabled staff and students to work together during the teaching period, with the focus on learning. It is recommended that assessment strategies be guided by the following blueto achieve constructive alignment:

- Aim to achieve a "web of consistency" whereby all aspects of the system align to unit learning outcomes.
- Embed effective formative feedback at the heart of the process: using feedback without marks to focus on learning during the teaching period.

- Perform a holistic summative assessment using clear criteria to determine final grades after the teaching period.
- Specify the assessment criteria to guide student behaviour so that student strategies are likely to align with desired behaviours.

blueUsing this assessment strategy enables staff to position themselves as being their to support student learning. The goals are set upfront and staff can work with students to help them achieve these goals. This is distinct from traditional approaches, with examinations and graded coursework assignments, which focuses the system on staff testing students rather then supporting students. In may regards the use of formative feedback with delayed summative grading flips assessment. This approach to assessment places the student at the centre, and makes them more responsible for demonstrating their learning. This changes the system dynamics, and by focusing assessment on appropriate learning outcomes we achieve constructive alignment that optimises the chance of focusing students on achieving the required understanding.

blueThe assessment strategy needs to be supported by educators adopting constructivist learning theories, with their central focus on the student in the learning process. To avoid potential issues related to some of the criticisms of constructivism and observed in this study, communication and guided instruction should be seen as means of assisting students in developing appropriate knowledge in a productive manner. This is in line with the pragmatic view of constructivism expressed in Biggs (1996). Therefore, it is recommended that constructivism be viewed as incorporating the following aspects:

- Knowledge is constructed in the mind of the student, not transmitted via communication *alone*.
- Teaching involves creating a context for learners to construct appropriate cognitive models through individual and social activities.
- Errors in understanding are opportunities for further learning, as these help indicate the students' current level of development and can be used to guide future learning activities.
- Communication can be a valuable tool for educators to help shape the learning context, but should not be seen as a means of knowledge transfer.
- Guided instruction is valuable and ensures student activity is likely to be productive, though students should also have opportunities to explore content in a context meaningful to them individually.
- Deliberate practice provides students with opportunities to engage with principles in action, but these activities should include opportunities to reflect on important aspects learnt.
- Value tasks that require students to engage in work that is authentic to the unit. Students should engage in tasks similar to those they are likely to encounter in a professional environment.

blueTo implement this approach requires teaching staff to adopt a Theory Y view of motivation. Placing the student at the centre of assessment, requires that staff trust and respect students, necessitating a predominant Theory Y view of motivation. In practice this includes the following:

- blueFocus on supporting student learning, and work to inspire and motivate students to engage with the required learning.
- Encourage students to take responsibility for their own learning.
- When issues arise, look to better support or facilitate student learning rather than adopting punitive methods of encouragement.

6 Conclusions and Future Work

This paper has presented an application of constructive alignment that extends the core principles to engage students by adjusting the approach to assessment. Using the proposed approach, students engage with unit tasks and frequent formative feedback cycles to guided them toward achieving the required levels of understanding. By using assessment as the central driving mechanism, students are appropriately motivated to engage with the unit and develop work to demonstrate they have achieved unit learning outcomes. blueThis work suggests that to achieve changes to system dynamics similar to those reported in the initial work on constructive alignment educators need to focus on using assessment to drive learning, in addition to adopting constructivist learning theories and aligning activities with unit learning outcomes.

blueThe findings of this work arose through action research and reflective practice, and therefore require further investigation to examine if they can be applied in other contexts. It is expected that these principles should apply across other domains and cultures, but this needs to be tested. Future work should look at further evaluating this approach, and supporting it with software tools to assist staff and students as they engage with the process described. It would be interesting to examine the application of this approach in other contexts, outside technical programming units. Ideally future work could look at applying this approach to other topic areas and at other institutions to see if the results can be replicated.

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