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The Application of Constructive Alignment Theory in Designing a Curriculum Unit in Information Systems

Japhet E. Lawrence

Faculty of Arts and Education, Deakin University, Melbourne, Australia.

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Corresponding author: Japhet E. Lawrence, Faculty of Arts and Education, Deakin University, Melbourne, Australia.

Abstract

The outcomes based approaches to learning have been shown to have a significant impact on student success in higher-order learning. Constructive alignment is an outcomes-based approach to teaching in which the learning outcomes that students are intended to achieve are defined before teaching takes place. Teaching and assessment methods are then designed to best achieve those outcomes and to assess the standard at which they have been achieved. It provides a framework for adjusting teaching and assessment to address the attainment of those outcomes and the standards reached. Constructive alignment is effective in designing teaching and assessment that enable students to learn, rather than to leave them guessing as to what is involved in the course of study or on what they will be assessed. The paper highlights the importance of using constructive alignment framework to enhance the quality of teaching, learning, and assessment. It reports on a study that applied the principles of constructive alignment to promote good teaching and deep student learning. It discusses the application of constructive alignment as curriculum design process and uses operational framework for this teaching design at the unit level.

Keywords

Constructive alignment, intended learning outcomes, curriculum, teaching, learning, assessment

1. Introduction

Teaching and learning take place in a whole *system*, which embraces classroom, departmental and institutional levels. A poor system is one in which the components (curriculum, teaching and assessment tasks) are not integrated, and are not tuned to support high-level learning (Lawrence, 2019; Liaqat Ali, 2018). In such a system, only the 'academic' students use higher-order learning processes. In a good system, all aspects of teaching and assessment are tuned to support high level learning, so that all students are encouraged to use higher-order learning processes. Biggs (1999) states that the focus of good teaching must be on what students are doing with the knowledge, skills and competencies they are acquiring, because learning doesn't occur through just listening, action is also required (Felder, 1997; Abdullah & Tarchouna, 2017). Learning takes place in a complex environment and there are many factors interacting within this system such as students' characteristics, teaching methods, curriculum, the learning objectives, and the institutional setting (Shuell, 1986). According to Shuell, if teachers want students to focus on understanding meaning, on developing high level cognitive skills like analysis and synthesis, then the learning activities that teachers design and assessment tasks have to be consistent with those objectives.

The traditional way of curriculum design defines the content to be taught, describe the ways in which the content should be delivered and the methods of assessing the content. The approach is teacher-centered and focuses on the teacher's input and it lays emphasis on content and coverage (Tam, 2014; Maffei et al., 2022). However, in recent years, there has been a paradigm shift taking place, moving the emphasis from teaching to learning and a more student-centered curriculum. This change has impacted on the curriculum design process with a greater emphasis on the learning in terms of knowledge, skills and competencies within courses and modules. The focus is on how learners learn and the design of effective learning environments. The assessment of learning is in terms of how well the students absorb the materials taught; most teachers assess students' needs and strengths by giving their students exams at specific times during the academic year, which generally occurs in one sitting. For example, multiple choice tests, true-false, fill in the blanks are traditionally used in assessing students and these types of assessment require either memorization or rote substitution. This type of exam has traditionally been the predominant instrument used for student assessment. For the most part, students are not allowed to participate in assessing their own progress or accomplishments. However, teachers have realized that 'academic exams' are a limited type of assessment; they do not thoroughly or accurately give a view of the students' academic development, performance and capabilities. These academic exams do not consider students' various learning styles, their personal backgrounds, their interests and their needs. Because of these limitations in traditional assessment, teachers have begun to use other types of assessment that are more responsive to student diversity (Maffei et al., 2019).

Diversity in higher education increases as students migrate all over the world and as more students from different social and economic backgrounds access education. Educational goals have moved beyond simple knowledge acquisition to promoting student engagement and higher order cognitive functions such as problem solving and critical thinking which are characteristics of deep learning. Teachers, now more than ever before, need to learn more about their students and their students' needs. Assessments that will help in this process and support students in overcoming barriers to learning are a means of helping both teachers and students.

A departure from this traditional paradigm is the student-centered approach where the emphasis is on what the students are expected to be able to do at the end of the learning experience. This approach is also referred to as an outcomes-based approach with statements used to express what knowledge students have acquired, and what abilities they have developed. The outcome-based approach differs from the traditional model; the outcomes not the content to be inputted are initially defined. Subsequently the delivery and assessment methods are developed to enable individual learners to achieve the learning outcomes (Harden, 1999). Outcome-based approach focuses on application and higher-level learning and it emphasizes on maximizing learning, it is student-centered in that the target is what the learner must achieve and how the learner may best be engaged to achieve it to the required standard. Alignment of assessment design with learning outcomes can enhance students' learning, and ensure teaching quality and standards. Implicit in the outcome based approach is the idea that teachers are facilitators of learning, who create and sustain an effective learning environment and experience based on a wide range of best practices in teaching and learning. Such radical shift from teacher delivery to student learning is resonant with the theory of constructive alignment (Biggs, 1996).

2. Constructive alignment

Constructive alignment theory (Biggs, 1996, 1999, 2003; Biggs &Tang, 2007, 2011) has been one of the most influential ideas in reforming the curriculum in higher education. Constructive alignment represents a marriage of constructivist learning theory and instructional design that highlights the importance of the learner‟s activities in constructing meaning during study. According to Biggs (2003), constructive alignment is a system that encourages students to use higher-order learning processes. This approach to teaching is learner-centered in that the target is what the learner has to achieve and how the learner may best be engaged in order to achieve it to the required standard. It is an outcomes-based approach described by Biggs (1996) as a teaching and learning strategy where learning objectives are explicitly defined and represent the intended learning outcomes (ILOs) of the course. It describes how learning outcomes should be achieved through teaching, learning and assessment activities that provide opportunities for learners to achieve and demonstrate the ILOs. Teaching is then designed to engage students in learning activities that optimize their chances of achieving those outcomes, and assessment tasks are designed to enable clear judgments as to how well those outcomes have been attained. As a model for curriculum design that optimizes the conditions for quality learning, constructive alignment emphasizes close and aligned connections between the essential elements of the curriculum, that is the aims, intended learning outcomes, teaching and learning activities and the assessment tasks are all aligned.

The basic principle of this concept is that the curriculum should be designed in a way that the learning activities and assessment tasks are aligned with the learning outcomes that are intended in the course of study (Biggs, 2003). It has been argued that using such alignment would help to "get students actively involved and assess them in ways that en-

hance the quality of learning" (White, 2012). Teachers should design their units in such a way that the intended learning outcomes, teaching and learning activities and assessment tasks adopted in evaluating students learning are well aligned with each other.

Constructive alignment is a theory of motivation and of planning which looks at teaching far beyond what goes on in the classroom (Brabrand, 2007). Therefore, the starting point when designing a unit should be based on what students should know and be able to demonstrate at the end of a particular unit. If there is a mismatch between teaching and assessment, this will have a negative impact on learning, however, if there is "alignment between what we want, how we teach and how we assess, teaching is likely to be much more effective than when there is not" (Biggs &Tang, 2007). Teachers should ensure that assessment improves the process of teaching and learning, for instance, when the lesson is aligned, higher cognitive processing will be required and thus the assessment exercises will similarly require higher order thinking skills and not simple recall of information (Biggs, 2003). Biggs' constructive alignment provides a useful operational framework for constructing learning by aligning teaching so that students can achieve the desired outcomes such as developing functioning knowledge or professionally relevant understanding (Biggs, 2003). The approach facilitates active students' engagement in authentic learning activities that are designed to achieve desired learning outcomes and assessment in terms of what students can do, rather than the declarative knowledge or knowing about information they can recite or write (Biggs, 2003). Figure 1 illustrates the underlying principles of constructive alignment, adapted from Biggs (2003).

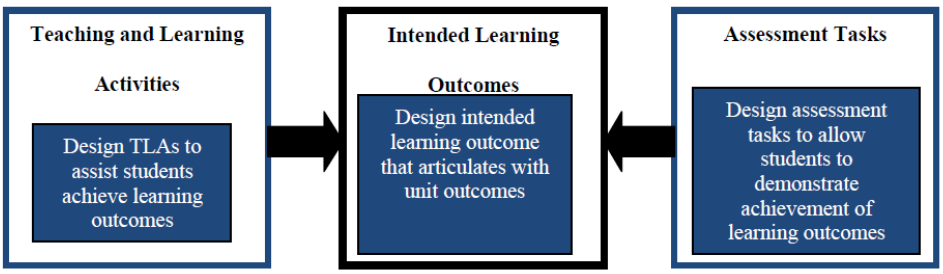

Figure 1. Constructive alignment of curriculum.

Constructive alignment arises from two fundamental principles. Firstly, constructivism can be defined as the construction of new meaning by the learner (Piaget, 1962). The 'constructive' aspect refers to what the student does, which is to construct meaning through relevant learning activities, rather than passively receiving instruction from the teacher. The constructivist student learns through discovery rather than merely the transfer of information from teacher to student (Biggs, 2003). That is, meaning is not something transmitted from teacher to learner, but is something learners must create for themselves. Teaching is simply a catalyst for learning, and in the end the students learn what they do, regardless of what the teacher may have intended (Boud & Falchikov, 2006). It is helpful to remember that what the student does is more important in determining what is learned than what the teacher does (Biggs, 2003). Constructivist education is therefore more than the acquisition of new knowledge; it promotes the development of critical thinking (Joseph & Juwah, 2012).

The second aspect alignment refers to what the teacher does, which is to set up a learning environment that supports the learning activities appropriate to achieving the desired learning outcomes. The ILOs require higher-level cognitive skills; the teacher must provide learning activities that foster development of such skills. This specifically involves selecting the most appropriate teaching and learning activities and assessment tasks for each of the learning outcomes. In addition, the learning environment must support this development and students are required to demonstrate the ILOs through appropriate assessments. The verbs in learning or curriculum objective statements are typically used as a basis for alignment and refer to the specific steps (or component activities) that collectively lead the students towards the outcomes (Biggs & Tang, 2011). The key is that all the components in the teaching system, especially the teaching methods used and the assessment tasks are aligned with the learning activities assumed in the intended outcomes. By aligning the assessment with the learning outcomes means that students know how their achievements will be measured. The learner is 'trapped', and finds it difficult to escape without learning what he or she is intended should be learned (Biggs, 2003). Within constructive alignment, learning outcomes are explicitly defined and made available to the student. There is a greater emphasis on the student to enable effective learning to take place rather than the activities of the teacher (Biggs & Tang, 2011).

Literature on curriculum development often describes an environment where students will develop a deep understanding of their chosen subject and be required to think creatively to solve problems. However, in reality many of these

courses deliver the curriculum through large lectures and assess recall of the factual content of the curriculum through formats such as multiple-choice questions. Neither the delivery nor the assessments are aligned to the aims of the course (Cobb, 2015). In the design and evaluation of an individual teaching activity, Canfield and Krockenberger (2002) use the structure of observed learning outcomes (SOLO) taxonomy (Biggs & Collis, 1982) to maximize constructive alignment. Results of the evaluation showed this approach to be successful in achieving desired learning outcomes through a student-centered approach (Canfield & Krockenberger, 2002). These conclusions are based on students' and teachers' perceptions of the teaching activity. The study did not include direct assessment of the learning outcomes, which is an essential component to the principle of constructive alignment.

Constructive alignment can provide a useful theoretical framework for curriculum design and development. Cobb (2015) indicates that only a small number of studies exist relating to constructive alignment within veterinary education. Cobb shows some example of studies that have used constructive alignment to develop curricula. According to Cobb (2015), Joseph and Juwah (2012) used constructive alignment theory to develop a nursing skills curriculum; the benefits included increased opportunity to practice skills and increased confidence in the students who experienced the constructive alignment curriculum compared to a control group. While Walsh (2007) explores constructive alignment in relation to work-based learning, Walsh suggests that the workplace provides a context that will allow active learning and generate a high level of motivation; this is consistent with the student-centered learning within constructive alignment. Walsh goes on to discuss the role of assessment in constructive alignment and its influence on student learning behavior. Walsh acknowledges the need for performance assessment within work-based learning, however, she fails to address some of the challenges these assessments provide (Cobb, 2015). From this limited research it is apparent that constructive alignment is considered an important concept to ensure a successful outcomes-based curriculum. However, the principals of constructive alignment are challenging and time consuming to implement (Cobb, 2015). Constructive alignment is used here within the context of Information Systems education as a framework for curriculum design and development.

3. Description of teaching context

3.1 ACIT118 Database Systems

The amount of information produced by different users with different technological devices, needs to be stored and organized in an effective and efficient manner. The proper management of data is essential for organization to easily access and manipulate these data for effective decision making within organizations. Successful database application development requires the practicing professional to possess a considerable theoretical base and an extensive repertoire of practical skills.

The unit described here is a bachelor level applied computing program for first year students. The unit is also available to non-computing students as elective. Database Systems is a one-semester core unit in the first year of a three-year bachelor of applied computing and information technology (BSc ACIT) degree program offered by the Department of Applied Computing and Information Technology. The number of students is around 60.

This unit deals with the process of designing and implementing database systems to satisfy user requirements. The unit provides students with theoretical knowledge and practical skills in the design and use of databases in organizational settings. The unit examines data modeling through the theory and practice of database design, implementation and use. The unit will introduce the concepts of database designs at the conceptual, logical and physical levels. The internals of database systems will be studied including how the database systems store data. Several database models are addressed, with a strong focus on the relational model and its theoretical grounding in sets and relational algebra. The process of problem decomposition into entity-relations, the design of appropriate relational schemas, and their refinement through normalization underlies the unit. Students will gain a working knowledge of database application development life cycle; models of systems development through individual study and practical exercises and group project.

The unit will place particular emphasis on introducing integrity constraints and the concept of data normalization which prevents data from being corrupted or duplicated in different parts of the database. Students will learn how to effectively design and create databases, and how to use them via the SQL query and manipulation language. Other topics covered will include issues surrounding the design of query languages and their implementation, d*atabase administration and* object-oriented data models. Students will undertake practical tasks including developing a relational database system using MS Access. The unit content to be taught is as follows:

Database system life cycle

- Data analysis (entity relationship models and normalisation)
- Database models (Hierarchical, Network, relational, object-oriented)

- Database design (logical and physical design)
- The SQL query language
- Database administration (security, backup, recovery, concurrent processing)
- Discussion of distributed database management (including client/server)
- Discussion of Object Oriented Database models (OODBMS and ORDBMS)

Essential Reading

- Kroenke, D M. (2006). *Database Processing: Fundamentals, Design and Implementation* (10th Ed.), Prentice Hall.
- Date, C.J., (2003). *An introduction to Database Systems* (8th Ed.), Addison Wesley.
- Connolly, T., & Begg, C. (2005), *Database Systems: A Practical Approach to design, Implementation and Management* (4th Ed.), Addison Wesley.
- Mannino, M.V. (2007). *Database Design, Application Development and administration* (3rd Ed.), Peason Education Inc.
- Rob, P., & Ccronel, C. (2007). *Database Systems: Design, implementation and management* (7th Ed.), Course Technology.

3.2 Applying the principle of constructive alignment in designing a curriculum unit

Constructive alignment is used here to demonstrate how a unit can be developed using the principles of constructive alignment in order to promote good teaching and deep student learning. Learning is a product of the student's activities and experiences, rather than the teacher's. The emphasis is on what students can do at the end of the learning experience. When designing a learning experience, the focus should be on learning outcomes, teaching and learning activities and assessment. It is important that there is agreement between the learning outcomes, the teaching and learning activities, and the assessment to make sure that the three elements are all aligned (Biggs, 1999, 2003; Biggs & Tang, 2007, 2011). The alignment ensure compatibility and consistency within the curriculum where the desirable learning outcomes agree with the teaching and learning activities and the assessment tasks in a coherent manner. The operational framework for curriculum design at the unit level is graphically represented in Figure 2.

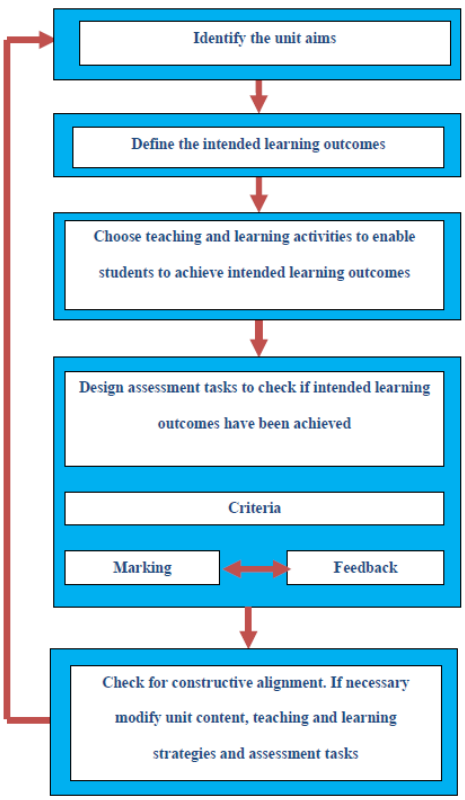

Figure 2. Operational framework for curriculum design.

Unit aims

In designing the curriculum is to make clear what levels of understanding we want from our students in that topics, and what performances of understanding would give us this knowledge. The first step is to identify the unit aims and the desired levels of student learning after engaging in a meaningful learning experience.

Aims are:

- Provides students with the necessary competence and analytical skills to develop a functional database system.
- Demonstrate the importance of database design in the overall implementation of information systems.
- Equip students to acquire knowledge and the essential skills needed for theoretical and practical aspects of computer technology and computer usage.

Intended Learning Outcomes (ILOs)

In setting up an aligned system, we specify the desired outcomes of our teaching in terms not only of topic content, but in the level of understanding of what we want students to achieve in fulfillment of the aims. The objectives are stated in terms that require students to demonstrate their understanding, not just simply tell us about it in invigilated exams. The intentions of the teacher expressed as learning outcomes (what the teacher intends the students will be able to do because of their learning). The intended learning outcomes (ILOs) for the unit are described using one or more verbs for each outcome. Action verbs are used in writing the outcomes statements that define the required level of understanding and competence. Verbs refer to an action at a particular level of cognitive or procedural difficulty (e.g. explain, reflect, analysis, integrate, present or evaluate etc) are used for different learning outcomes at various levels that need to be very specific at the outset for both students and teacher to have a clear idea of what is expected at the end of the learning experience. Currently, Bloom's Taxonomy (1956) is used as a basis for categorizing outcome statements according to the cognitive ability they elicit. Incorporating verbs in our intended learning outcomes gives us markers throughout the system. The same verbs need to be embedded in the teaching/learning activities, and in the assessment tasks. Then we systematically align the teaching/learning activities, as well as the assessment tasks, to the intended learning outcomes. This is done by requiring the students to engage the learning activities required in the outcomes (Biggs & Tang, 2011). A constructively aligned curriculum is one in which all key aspects of the curriculum are consistent and supportive of each other. A unit that features constructive alignment is clear about the intended learning outcomes. The ILO denotes how the content or topics are to be dealt with and how well each topic needs to be understood. It is results-oriented and the primary measure of curriculum success is what students know and are able to do. The focus here is aligning a semester length unit.

On completion of this unit, students will be able to:

ILO1 Describe the basic concepts of database systems, their Characteristics, architecture and systems life cycle.

ILO2 Explain the social, economic and ethical aspects in the development, implementation and use of database systems in organisational settings.

ILO3 Analyse and design a database system using modelling techniques such as entity relationship modelling and normalisation.

ILO4 Create database queries using language SQL (Structured Query Language) to extract information from large datasets.

ILO5 Design and develop a relational database systems using Microsoft Access.

ILO6 Evaluate the role of database management systems in information technology applications within organisations.

Teaching and Learning Activities (TLAs)

Having decided on the level and nature of learning outcomes, the second step is to consider what students need to do to be able to achieve the intended learning outcomes. This process informs the kind of student activity that is linked to the level of each ILO in the curriculum. The teacher needs to plan and choose the most appropriate teaching/learning activities to enable students to achieve the intended learning outcomes. To elicit the high-level verbs and encourages students to use higher-order learning processes, the teacher needs to create a learning environment that maximizes the likelihood that students will engage in the activities designed to achieve the intended outcomes. The chosen teaching/learning activities should require students to engage each verb in the ILOs. In this way, the activity nominated in the ILO is activated. The teacher then engages the students to facilitate these learning activities through the teaching process. It is no longer enough for teachers to be competent in their discipline; they are required to create, develop, and manage stimulating learning environments, using a variety of resources, methods, and technologies, including assessment resources in order to deepen and enrich student learning. Such a shift for the role of teacher from subject expert to facilitator of learning implies that teaching and learning activities are designed to reflect this relationship to focus more on the educational process rather than subject content. A range of different TLAs are used for this unit, which are a rich

source of relevant learning activities. The teaching/learning activities used for this unit is shown below.

TLA1: Interactive lecture

Concepts and general knowledge of Database systems are presented with PowerPoint slides:

- Concept map: at the end of a lecture segment, the lecturer uses the concept maps to demonstrate links between various topics presented in the lecture. Lecturer provides students with lists of concepts relative to their course and ask students to create a meaningful pattern with these concepts (e.g. entity relationship).
- Incomplete PowerPoint slides: PowerPoint presentations provided the week before the lecture have had key words and figures on certain slides omitted. Students are encouraged to prepare before their classes and to participate during classes to complete the missing information.
- Role play: students act as systems analysts and clients to simulate interviewing the client for systems user requirements.
- Minute-paper note: At the end of a lecture segment, the lecturer asks students to spend a minute or two minutes to write down the questions they have about the lecture, 3 key points of the day, indicate points they don't understand. In the next lecture, the lecturer provides feedback based on students' concerns in their one-minute notes.

Major focus: ILOs 1, 2, 3 and 6; minor focus: ILOs 4 and 5.

TLA2: Tutorial

Students are required to team up with their group and participate in the following activities:

- Tutorial assignments: assignments are specifically assigned to give students opportunity to think through the concepts and the principles of data modelling with entity-relationship model and to apply the concepts to application design and implementation.
- Role play: students act as systems analysts and clients to simulate the user requirements, analysis, design phase of Database system life cycle.
- Tutorial exercises and activities: students respond to and participate in in-class exercises and activities. They are required to explore in detail the theoretical concepts of the lectures that need further explanation.
- Group discussion and case study: discussion on major issues or questions arising from the case studies assigned for their group projects.

Major focus: ILOs 3 and 6; minor focus: ILOs 4 and 5.

TLA3: Computer laboratory

Technical aspects of SQL and database systems design and development are covered:

- Laboratory exercises: hands-on activities on SQL and Microsoft Access.
- Group project discussion: discussion on various aspects of the group project.

Major focus: ILOs 3 and 4; minor focus: ILO 6.

Assessment Tasks (ATs)

What follows from the stage of designing appropriate teaching and learning activities is the very important part played by assessment to demonstrate that students have achieved in the end the kind and level of learning expected of them. A fundamental principle underlying successful learning and teaching is the aligned curriculum (Biggs & Tang, 2011). Designing assessment tasks is probably the greatest challenge in curriculum development. Constructive alignment calls for virtually simultaneous consideration of the desired learning outcomes, the planning of appropriate teaching and learning activities and the proposed means of assessment to aim at the desired level of cognitive and effective outcomes which are declared as results from a worthwhile learning experience. The key to achieving this goal is that all components in the teaching system (i.e. teaching process from planning through assessing) are aligned to each other to facilitate the achievement of the intended learning outcomes.

We choose assessment tasks that will tell us how well individual students have attained these outcomes, in terms of graded levels of acceptability. A range of different assessment tasks are used to ensure students have experiences to develop the skills needed for the unit. Assessment tasks are designed using methods that enable students to demonstrate the intended learning and evaluating how well they match what was intended. The assessment tasks link to the learning outcomes and students know that by engaging in the learning and teaching activities, they will have the best chance to perform well in the assessment tasks. By aligning the assessment with the learning outcomes means that students know how their achievement will be measured.

It is important that the assessment tasks mirror the intended learning outcomes, as Ramsden (1992) puts it, as far as the students are concerned, the assessment *is* the curriculum: "from students' point of view, assessment always defined the actual curriculum". That is students will learn what they think they will be assessed on, not what is in the curriculum or even on what has been covered in the class. It is important to ensure that there is alignment between teaching meth-

ods, learning outcomes and assessment tasks. Clear expectations on the part of students of what is required of them are a vitally important part of students' effective learning (Ramsden, 2003). This correlation between teaching, learning outcomes and assessment helps to make the overall learning experience more transparent and meaningful for students. Biggs (2003) represents this graphically as follows (Figure 3):

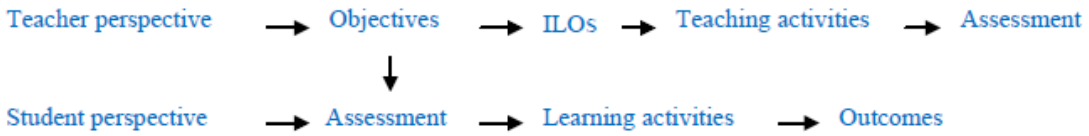

Figure 3. Biggs (2003) represents this graphically.

"To the teacher, assessment is at the end of the teaching-learning sequence of events, but to the student it is at the beginning. If the curriculum is reflected in the assessment, as indicated by the downward arrow, the teaching activities of the teacher and the learner activities of the learner are both directed towards the same goal. In preparing for the assessment, students will be learning the curriculum" (Biggs 2003). The intended learning outcomes in the unit are assessed with the mode of assessment specified for each outcome of the unit. The assessment tasks selected for the unit include tutorial assignments and participation, laboratory exercises, group projects, mid-term test, and final examination. The selected tasks are shown below.

AT1: Tutorial assignments and participation (10%)

Assignment (10%) is given to access the student logical database design (analysis of users' data requirements, apply normalisation to the data and show relationship to data with entity relationship modelling)

Major focus: ILOs 1, and 3; minor focus: ILO 6.

AT2: Laboratory exercises (10%)

Exercise (10%) is given to access the student's competence level working with SQL and Microsoft Access

Major focus: ILOs 4 and 5; minor focus: ILO 6.

AT3: Group projects (20%)

The group project is divided into two phases: each is designed to access the student ability to produce systems analysis and design documents based on an assigned case study; transform the logical to physical relational database design using MS access.

Major focus: ILOs 3, 4, and 5; minor focus: ILO 1.

AT4: Mid-term test (20%)

The mid-term test is designed to gauge the student's grasp of database systems concepts and knowledge, as well as the ability to apply them to solve organisational problems in various situations.

Major focus: ILOs 1, 2, and 4; minor focus: ILO 6.

AT5: Final examination (40%)

The final examination is designed to gauge the student's grasp of database systems concepts and knowledge, as well as the ability to apply them to solve business problems in various situations.

Major focus: ILOs 1, 2, 3 and 6; minor focus: ILO 4.

3.3 Analysis and aligning ILOs, TLAs and ATs

Alignment is central to effective assessment -there should be a clear relationship between intended learning outcomes (statements of what the learner should be able to do as a result of the teaching) and assessment. The alignment refers to what the teacher does, which is to set up a learning environment that supports the learning activities appropriate to achieving the desired learning outcomes that helps students make sense of what they are learning. This specifically involves selecting the most appropriate teaching and learning activities and assessment tasks for each of the learning out-

comes. Constructive alignment links the unit aims, ILOs, TLAs and ATs and describes the relationship between the elements. The components in the teaching system, the teaching methods used and the assessment tasks are aligned with the learning activities designed to achieve the intended learning outcomes. The constructive alignment process is iterative and there is movement in all directions between the three main sections: intended learning outcomes, teaching and learning activities and assessment task.

A thorough analysis of the example unit using the process of constructive alignment demonstrates every element of the unit is aligned. The level of thinking required for each ILO is identified as it is clear that the levels of thinking required for assessment task or teaching and learning activities did not always align with those of the ILO. This process resulted in rewriting of ILOs to improve clarity and improve the overall aim of the unit in terms of skill and knowledge development. As Kift (2009) puts it, the purpose in this process is to ensure that the unit is designed to develop academic and professional skills. The analysis of the content of the assessment task ensures that the assessment task is aligned with the ILOs and TLAs. This includes contents of lectures, activities undertaken in lectures, tutorials, and lab resources to support the activities. Any other resource, activity or action used in teaching is documented and evaluated to determine its use in the unit and direct relationship to what the students need to learn.

The analysis of the TLAs alignment between the intended learning outcomes and the assessment tasks identifies knowledge and skills needed to be taught in order for the students to be able to demonstrate their learning based on the intended learning outcomes. The analysis identifies gaps in content and delivery while noting what is already occurring in the unit. Each intended learning outcome is analysed and mapped against Bloom's taxonomy to develop an understanding of what students are being asked to do so that appropriate learning activities are designed to suit the development of skills and knowledge throughout the unit. After the analysis and mapping against Bloom's taxonomy, the principles of constructive alignment (Biggs, 2003) were applied to ensure that assessment tasks and learning activities are aligned to the unit intended learning outcomes and to guide the design of learning experiences. This analysis raised awareness of the activities that students are expected to action in the learning process. The framework consists of a linear analytical table to record the unit intended outcomes, assessment tasks, and teaching and learning activities that assist in identifying how assessment aligns with the ILOs. See Table 1, it shows ILOs, TLAs and ATs that assisted in ascertaining the skill development and the knowledge required to apply learning to practice and assessment through alignment across the table. Analysis of the assessment content ensures that the assessment aligned with ILO and the TLAs that include content of lectures, tutorial and laboratory exercises. Assessment types are identified to ensure that students have a range of different assessment experiences to develop the skills needed for the unit.

Table 1. Aligned ILO, TLAs and ATs

TLAs	ILOs	ATs	ILOs
TLA1	ILOs 1, 2, 3 & 6	AT1	ILOs 1 & 3
TLA2	ILOs 1, 3 & 6	AT2	ILOs 4 & 5
TLA3	ILOs 1, 3 & 6	AT3	ILOs 3, 4 & 5
		AT4	ILOs 1, 2 & 4
		AT5	ILOs 1, 2, 3, & 6

3.4 Using rubrics for grading assessment

Rubrics are developed to assist faculty in measuring engagement of students with the learning outcomes and aims of teaching (Campbell, 2005). A rubric is a tool that has the potential for helping teachers to formatively assess students' performance during the teaching/learning process by clearly establishing the standards and quality expectations (Seymour, 2005). It assists in customizing the student feedback: what a student has done well; what weaknesses exist; and how or what might be done to correct or improve the performance. Information obtained from the summative use of rubrics can be utilized to formatively report student progress toward the agreed upon learning outcomes. A rubric consists of a set of criteria and marks or grade associated with these criteria (Seymour, 2005). It provides a clear guide as to how students' work will be assessed and assists the marker to make consistent and reliable judgments about the quality of student work. Rubrics are commonly presented in the form of a matrix that includes: marking criteria—the elements that describe the extent of proficiency required for a given task that the marker will consider when judging a piece of work (such as quality of argument, technical aspects, etc). Grading standards—descriptive statements about the level of each criterion, often expressed on a scale (such as Distinction, Credit, Pass, Fail, or a number score).

Rubric is used to prepare for the database unit assessment. One of the main benefits of using rubrics is that it helps to ensure that the assessment of engagement with teaching material is carried out in a clear, open and fair manner. It makes clear to students the criteria against which their work will be assessed and how the learning and teaching undertaken fully fits into the criteria (Huba & Freed, 2000). The most important function of a scoring rubric, however, is in

providing both formative (ongoing) and summative (after marking) feedback to students and feedback to staff on students' learning and thus the effect of their teaching (Huba & Freed, 2000). According Stevens and Levi (2005), they indicate that the use of a scoring rubric enables students to hand in work that is better in quality than they might otherwise have done. Students do not have to guess or infer what the teacher wants; and teacher are forced to articulate and, if necessary, quantify the most valued outcomes of students' learning (Stevens & Levi, 2005). Learning outcomes were graded qualitatively in the first instance, then a percent awarded according to how well the student performance matched that grade. The intended learning outcomes and grading criteria that are used for the database unit is shown in Table 2 below to illustrate the grading of assessment, while table 3 shows only rubrics for tutorial assignment and participation.

Table 2. Breakdown of assessment grades

Excellent	**Very good**	**Good**	**Marginal**	**Fail**
A+ = 97-100 A = 91-96 A- = 86-90	B+ = 82-85 B = 76-81 B- = 72-75	C+ = 68-71 C = 60-67 C- = 55-59	D+ 50-54 D = 45-49 D- = 40-44	F = 0-39

Table 3. Rubric for tutorial assignments and participation (AT1)

ILO	Criteria	Excellent	Very good	Good	Marginal	Fail
ILO1	Database system concepts and architectures	Demonstrate sound knowledge of most materials covered, able to describe all concepts of database systems and to identify relationship between difference concepts	Able to describe various major concepts of database systems with thorough comprehension of each and able to discriminate between different concepts	Able to recall and describe some important concepts of database systems and able to show some linkages between different concepts	Able to recall major concepts of database systems with simple description, with ability to grasp linkages between a small number of concepts	Unable to recall any concepts of database system
ILO3	Entity-relationship data modelling and normalization	Able to eliminate all dependencies in a database schema via normalization and demonstrate thorough knowledge of the elements of the ER model, and how to build ER diagrams from functional requirements	Able to eliminate most dependencies in a database schema via normalization and demonstrate Sufficient knowledge of the elements of the ER model, and how to build ER diagrams from functional requirements.	Able to eliminate some dependencies in a nontrivial database schema via normalization and demonstrate knowledge of the most key elements of the ER model, and how to build ER diagrams from functional requirements	Able to eliminate obvious dependencies in a simple database schema via normalization and demonstrate knowledge of some basic concepts of the ER model, and how to build ER diagrams from functional requirements for simple cases.	Unable to eliminate any dependency in a database schema via normalization and demonstrate no knowledge of any concept of the ER model.

4. Conclusion

The widespread interest in the outcomes of educational experiences has resulted in a shift away from the teacher-centred approach that emphasizes what is presented, towards the student-centred model focusing on what students know and can do. Learning outcomes are defined according to the context in which they are used, outcomes help students understand what is expected of them at the end of an educational experience. Learning outcomes are useful to guide curriculum, learning and assessment to aim at the achievement of those competencies or abilities by students enrolled in a course. Constructive alignment provides solution and a useful framework for understanding the process of learning and assessment. A constructivist understanding of learning starts with the notion that the learner constructs their learning through relevant activities underpins the approach. It uses a structured teaching approach that focuses

students on meeting the unit intended learning outcomes.

The basic foundation of constructive alignment is that in a good teaching system, the curriculum is designed so that the learning activities and assessment tasks are aligned with the learning outcomes in the course. All aspects of teaching and assessment are tuned to support high level learning, so that all students are encouraged to use higher-order learning processes. A poor system is one in which the components (curriculum, teaching and assessment tasks) are not integrated, and are not tuned to support high-level learning. In such a system, only the 'academic' students use higher-order learning processes. Constructively aligned teaching seems to produce high quality learning outcomes and student satisfaction. This occurs when three key curriculum elements: the intended learning outcomes; the teaching and learning activities, and the assessment tasks are balanced. Effective alignment ensures consistency throughout the teaching system, the intended learning outcomes are made transparent and communicated to the learner and the lecturer selects and uses teaching and learning methods likely to achieve the intentions and assessment tasks reflect those intentions. The entire system 'enables' the student to learn, rather than to leave them guessing as to what is involved in the course of study or on what they will be assessed.

Constructive alignment is essential components in the outcomes-based approach, the three elements—outcomes, teaching and learning, and assessment need to be aligned to achieve consistency and coherence in the curriculum design process. It is important to ensure that there is alignment between teaching methods, learning outcomes and assessment tasks. Clear expectations on the part of students of what is required of them are a vitally important part of students' effective learning.This correlation between teaching, learning outcomes and assessment helps to make the overall learning experience more transparent and meaningful for students. By aligning the assessment with the learning outcomes means that students know how their achievement will be measured. Rubrics enable faculty to provide detailed and informative evaluations of students' work. It is important that rubric is drafted from the learning outcomes set, and represents the content delivered to students. The adoption of constructive alignment has the potential to help embrace a more systematic approach to the design of courses.

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