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QUALITY LEARNING ASSURANCE USING STANDARD CURRICULUM LEARNING OUTCOMES MAPPING

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ABSTRACT

Academic degree learning outcomes identify concrete skills and knowledge the students must develop and be able to apply upon completion of the study program. A curriculum learning outcomes mapping provides a visual representation of the relationship between a programs' learning outcomes and the courses offered to its students. A mapping can help improve the coherence of the curriculum and help students achieve the program's learning outcomes. This paper will show the widely used models to design or define the learning outcomes mapping. Many standard models of outcomes mapping from international universities will be illustrated and compared in this piece of work. The research also tries to introduce a curriculum learning outcomes mapping framework, based on revised Bloom's taxonomy that assists stakeholders of higher education institutions in tracing concept development and assessment throughout their academic programs. This study also demonstrated a curriculum learning outcomes mapping methodology that can be used to make sense and use existing data in curricular evaluation. The purpose of this paper is to find learning outcomes mapping model that is suitable, informative and vital to design academic degree curriculum at the higher education institutions, in order to unify and simplify the program accreditation process. This research proposed using the 24 cognitive category levels of Revised Bloom's taxonomy as a mapping model, and the resulted model are called the 24 knowledge dimensions mapping model. The performance of the 24 knowledge dimensions mapping model was tested and compared with four similar models. The test results showed that the 24 knowledge dimensions mapping model has higher effective grades than the four selected standard models.

Keywords: Curriculum Design, Degree Program Outcomes, Bloom's Taxonomy, Learning Outcomes Mapping Models.

Subject area: (Please put a "X" as appropriate)

X	a)	Accreditation (In its broadest sense)
	b)	Research (related to Internationalisation either linked to students or partnerships with international establishments)
	c)	Affiliation (with International partners involved in HE)
	d)	International students and sponsorship

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1. INTRODUCTION

Emerging trends in workforce development are change according to local and global market demands and the modern requirements in various industries. To satisfy the modern markets and industry requirement; the capabilities, knowledge, and skills required by higher education institution graduates are likely to develop in a faster pace as compared to previous years (Conley & Gaston 2013). It is obvious that main factor which drives learning, is the ability to apply knowledge in market demands context. Skills and training must be combined with opportunities to engage knowledge and apply skills to provide the community with its labor force needs. The switch in the manpower growth sector will affect the changes of educational degree programs, in developing individuals for future careers (Welsh & Metcalf 2003). The curriculum of the academic programs should be able to satisfy three provisions; develop knowledge that is pertinent to the industry needs, transfer skills necessary for a variable environment, and abide to certain sector quality accreditation benchmarks. The higher education institutions must adapt their curriculum components to ensure that their academic degree programs are designed according to the employer's needs, instead of focusing only to fulfil academic criteria. Internationally, industry chiefs understand that along with the acquisition of knowledge also services to the society through innovations with the help of attained knowledge are important (Uchiyama & Radin 2009).

The curriculum is an implicit mix of learning outcomes, educational strategies, course content, educational experiences, assessment tools, learning style, the educational environment, and the

timetable for the academic program. The curriculum learning outcomes interpret the actual industry and market requirements which academic degree program graduates should satisfy. Academic institutions cross their wanted learning outcomes at the program curriculum level which will be inherited by its role to the courses level syllabi of that academic degree. Curriculum learning outcomes characterize observable and commensurable knowledge, skills, and behavioral values that the student must gain at the end of the learning journey (Plaza et al.2007).

Curriculum Learning Outcomes mapping is adopted to be used as a tool for checking whether a curriculum is designed as planned and relevant to achieve the anticipated employment learning outcomes. Curriculum Learning Outcomes mapping also satisfy the prerequisites of Outcome Based Education (OBE), and to make learning and teaching a more significant experience to students and faculty members. Different mapping methodologies are used around the world by the academic institutions. Most academic studies at the field of curriculum design methodologies represent the learning outcomes mapping by a matrix representation or textual description which shows the relationship among the degree learning outcomes across various courses compose of the degree program (Uchiyama & Radin 2009).

Bloom's taxonomy is the most important methodology used to design the learning outcomes mapping that classifies the human learning abilities and skills, in order to reflect different cognitive levels (Anderson & Krathwohl 2001). This article aims to evaluate several learning outcomes mapping models and try to investigate the use of the modern revised Bloom's taxonomy by Anderson and Krathwohl (Krathwohl 2002) as a standard tool, to represent curriculum learning outcomes mapping, especially in quality assurance accreditation process. The applied content analysis method interbreeds with hypothetic deductive search methodology used in this work, to satisfy its purpose and reach its objectives. Finding concise, simple, informative, reliable and well documented learning outcomes mapping template for the academic curriculums is the aim of this work.

2. LEARNING OUTCOMES

Curriculum design focusses primarily on the development of systematic process, to lead the academic staff identify their instructional aims and learning objectives, improve study materials, and teaching activities to support those objectives. The systematic curriculum development process can be summarized by: (I) Identify student learning outcomes of the academic degree, (II) build the curriculum outcomes mapping, (III) determine the methods of assessment, (IV) gather evidence that support the curriculum, and (V) use results to formulate the curriculum according to a standard format or template (Falkner et al.2013). Learning outcomes should be measurable and must determine the knowledge to be acquired, skills to be taught, attitudes to be behaved, and the values a graduate should have. Learning outcomes importance came from deliver expectations to the students, act as a template for courses design, guide selection or design of appropriate assessments tools, allow faculty, staff and researchers to assess the impact of instruction, clearly communicate graduates' skills to prospective employers, provide benchmarks for formative summative and prior learning assessment (Harden 2001).

Knowledge represents what students should know by the time they complete the program (the most important terms, concepts, theories, and principles) and what methods and procedures they should practice. Skills determine what students will be able to do with what they know, what types of skills they should demonstrate, what performance skills or competencies they should demonstrate, what skills they need to solve problems in the discipline, what types of research experiences students should have. Attitudes and values show what students care about, what values or attitudes should they develop what should they appreciate or respect, what ethical issues should they be able to address (Krathwohl 2002). The main sources for learning outcomes collections are; written descriptions of the program, mission statements, teaching goals inventory, accreditation agencies, professional or certification exams, course syllabi, and colleges which have the same academic degree specialization. Bloom's taxonomy is used to describe the major components of the learning outcomes (knowledge, skills, attitude, and values), which student should achieve by the end of a program. The action verbs of Bloom's taxonomy are to make sure that the learning outcomes can be observed and measured and ensure that outcome is clear and understandable to students (Anderson & Krathwohl 2001).

3. CURRICULUM LEARNING OUTCOMES MAPPING

Curriculum learning outcomes mapping can help both faculty members and students by prominent key elements of the curriculum, and the relationship between those elements. Faculty members will have a complete view of their role in the field of educational process and students can identify what and how they can learn (Conley & Gaston 2013). The domain and range of student learning is made obvious and the assessment methods are clarified so that curriculum planning becomes more effective and efficient. In this way the degree curriculum is clearer to all the high deduction institute stakeholders including the curriculum designers, faculty members, students, admin staff, the researcher, and public (Uchiyama & Radin 2009).

To reflect different cognitive levels, Bloom's taxonomy divides the education targets into six levels, including: knowledge or remembering, understanding or comprehension, applying or application, analyzing or analysis, evaluating or evaluation, and creating or synthesis (Krathwohl 2002). At the same time, it also setup the corresponding action verbs for each level of cognitive goal. The remembering level include: define, list, recognize. The understanding levels include: characterize, describe, explain, identify, locate, recognize, sort. The applying level includes: choose, demonstrate, implement, and perform. The analyzing level includes: analyze, categorize, compare, and differentiate. The evaluating level includes: assess, critique, evaluate, rank, rate. The creating level includes: construct, design, formulate, organize, synthesize. Bloom's taxonomy is a very good inspiration to design academic programs learning outcomes and mapping it (Anderson & Krathwohl 2001).

Curriculum learning outcomes mapping can help determine degree of coverage of academic degree learning outcomes. The main purposes of curriculum learning outcomes mapping include: demonstrate the alignment between curriculum and the program’s learning outcomes, identify which courses contain learning experiences which help student achieve learning outcomes, shows the extent to which learning outcomes are addressed, details of assessments tool suitable for each course according to the learning outcomes (Falkner et al.2013). Learning outcomes mapping can help to: show where gaps are if some learning outcomes are not being covered sufficiently, points to where, when, and how assessment can take place, contributes to foundation of a program assessment plan, and provides an overview of curriculum (Welsh & Metcalf 2003).

Simple method to create a curriculum learning outcomes mapping is to begin with a table with learning outcomes listed on the vertical axis and all courses listed across the horizontal axis at the top. Each learning outcome will have a row and each course will have a column. Each learning outcome indicates in which course(s) the outcome is addressed. Each learning outcome must be addressed at least once, if not, then the learning outcome and its place in the program should be re-examined (Jennifer 2008).

4. MODELS OF CURRICULUM LEARNING OUTCOMES MAPPING

Curricula are the core elements of colleges and universities, and the learning outcomes mapping is the most significant part of the curricula, which tends to focus on identifying the learning outcomes that undergird curricula (Kuh 2014). There are many templates that can be used to define the curriculum and each one uses its own learning outcomes mapping. Each education institution may apply different template according to its learning vision or the curriculum template used to define its program degrees. But for standardization and accreditation purposes some countries and universities, enforce unified course template for its degree programs (Louay & Mastan 2017). Many models can be recognized about those modern standard templates such as: The University of Hawaii at Manoa, Hong Kong Institute of Education, Northern Virginia Community College, and Metropolitan State University of Denver models.

As mentioned in the introduction of this work; the descriptive strategy combined with hypothetical deductive method, will be used in this paper to satisfy its aim and accomplish the objectives. The descriptive research strategy will be used to describe the above-mentioned models. The concise description for those standard models will be providing this study knowledge required for components of each model and be able to compare between them on this paper. The four standard models will be listed and concisely described as follows:

a) The University of Hawaii at Manoa model (UHM): This model was designed by UHM to help staff to create a learning outcome mapping that contain the most useful information to enhance student learning. The model designed as a table with one column for each learning outcome and one row for each course or required event or experience (or vice versa: each row contains a course and each column lists a learning outcome). The table entries are marked which represent the intersection between the courses and learning outcomes by enter; "I" to indicate students are introduced to the outcome, "R" indicates the outcome is reinforced and students afforded opportunities to practice, "M" indicates that students have had sufficient practice and can now demonstrate mastery, and "A" indicates where evidence might be collected and evaluated for program level assessment (collection might occur at the beginning and end of the program if comparisons across years are desired) (University of Hawaii 2017). Table 1 shows example of that mapping.

Table 1. The University of Hawaii at Manoa model.

Courses	**Intended Student Learning Outcomes**			
	Apply the scientific method	Develop laboratory techniques	Diagram and explain major processes	Awareness of careers and job opportunities
C101	I	I	I	
C102	R		R	R
C103	R,M	R,A		I,M
C104	I, R,M	A	A	
:				..

b) Hong Kong Institute of Education model (HKI): This model aims to evaluate the alignment between subject learning outcomes (SLOs) that represent the role of the curriculum and the course curriculum documents. The model sketch as a two-dimensional table where the first column lists the desired learning outcome of concerned curriculum and the rest of the columns list the courses of that curriculum. The table cells fill by a code number between one and five. A coding system was used, in which 1 represents Professionalism, 2 represents Student Centered Pedagogical Practices, 3 represents Assessment and Evaluation, 4 represents Planning, and 5 represents Theory and Knowledge (Bick & Kwok 2016). Table 2 shows example of that mapping model.

Table 2. The Hong Kong Institute of Education model.

Learning outcomes	**Courses of the Curriculum**				
	Course 1	Course 2	Course 3	....	Course m
LO1	1,3	4,5	3,5		1
LO2	2,3,4	1,3,5	2		5
:					
LO n	3,4	2,3	3,4,5		2,4,5

c) Northern Virginia Community College model (NVC): Northern Virginia Community College design its curriculum mapping to demonstrates the alignment between curriculum and a program's learning outcomes and to identifies which courses contain learning experiences which help student achieve that outcomes. Also, the model shows the extent to which learning outcomes are addressed and details which courses contain assessments for that learning outcomes. The mapping creation process begins with a table listed learning outcomes on the vertical axis and all courses listed across the horizontal axis at the top. Each Learning outcome will have a row; each course will have a column. Then the level to which the outcome is addressed is described by the indicators where "I" denoted Introduced, "P" for Practiced and "M for Mastered. The learning outcome can be addressed for more than one level within a course. The method of assessment is also provided for the program level assessment, at the table entries (Jennifer 2008). Table3 shows example of that mapping.

Table 3: The Northern Virginia Community College model.

Learning outcomes	**Courses of the Curriculum**				
	Course 1	Course 2	Course 3	....	Course m
LO 1	I, Test	P	I		M, Quiz
LO 2		M, Project			P
:					
LO n	M, Test	P, Test			I

d) Metropolitan State University of Denver model (MSU): Metropolitan State University uses curriculum learning outcomes mapping to provide an overview of the structure of the curriculum and the contribution of individual courses to the goals of the program and identify program strengths student learning outcomes that are thoroughly addressed. Also, to help departments identify gaps (learning outcomes that are addressed by only a few courses) and suggest whether students take courses in an optimal sequence. The mapping as advising tools provide students with an overview of the role of each course in the curriculum and why some courses should be taken in a order. The mapping design focused on curriculum and program learning outcomes as a two-dimensional matrix representing courses on one axis and outcomes on the other. The matrix cells identify which courses address which learning outcomes. Each course should be linked within at least one learning objective and one level by entering the appropriate letter(s) in the relevant cell. The levels are stated from the curriculum perspective and tied to Bloom's taxonomy as much as possible. The "V" uses for discovering (gain knowledge), "P" for Practice (apply knowledge), and "D" for Demonstrate (evolution of knowledge). A course might be identified as offering students the opportunity to do more than one level (Natasha 2014). Table 4 shows example of MSU mapping.

Table 4: Metropolitan State University model.

Courses	**Learning Outcomes Objectives According to Bloom's Taxonomy**			
	Learning Objective 1	Learning Objective 2	Learning Objective 3	Learning Objective 4
C101	V, D		P, D	
C102	D	V, P	V	P
C103	P, D	V	P	D
:				..

5. THE FOUR MODELS ANALYSIS

The learning outcomes mapping outlines the specific knowledge, personal qualities and skills to be taught, assessed and evaluated for reporting student’s achievement. In this part of the work, a summarization and comparison will be made between the four standard models. The comparison is made by comparing the relevant sections in each template. According to individual component comparisons, the total comparison results can be drawn. The individual analysis of each standard model and the total comparison results can be listed within Table 5. The comparisons result between the four models will be made according four features; the application rank according to Bloom's taxonomy, the grade of clearness, the amount of information, and the international stage (Louay 2015). For easiness, the features will be graded in two values; Realized (R) and Unrealized (U).

Table 5: The Four Models analysis.

Comparison Feature	**Learning Outcomes Mapping Model**			
	UHM	HKI	NVC	MSU
Bloom's Ranke	R	U	R	R
Clear	U	U	R	R
Informative	U	U	U	U

Internationality	R	R	U	R
Total Number of R	2	1	2	3

6. CUSTOMIZE STANDARD MODEL

The comparisons between the four standard models have shown that models have insufficient scores at field of standardization requirements because of its informal unification. To satisfy the objectives of this work in finding learning outcomes mapping that is suitable for international program accreditation requirements; the hypothetic deductive method will be used to satisfy that purpose and reach the objectives. The hypothetic deductive method will be used to prove the hypothesized customized standard template. The hypothesis of this work is "The 24 Knowledge Dimensions model (24KD) according to revised Bloom's Taxonomy is more suitable for the higher educational institutions as program accreditation learning outcomes mapping tool".

The revised Bloom's taxonomy classifies the cognitive skills into six main categories (Remembering, Understanding, Applying, Analyzing, Evaluating, and Creating) and each category also subdivided into four levels of knowledge (Factual (F), Conceptual(C), Procedural(P), and Metacognitive(M)) (Anderson & Krathwohl 2001). Revised Bloom's taxonomy resulted into 24 cognitive category levels. The factual knowledge represents the basic elements students must know to acquaint with a discipline or solve problems. The conceptual knowledge represents the interrelationships among the basic elements within a larger structure that enable them to function together. The procedural knowledge shows how to do something, methods of inquiry, criteria for using skills, algorithms, techniques, and methods. The metacognitive knowledge gives knowledge of cognition in general, as well as awareness and knowledge of one's own cognition (Krathwohl 2002).

With the 24 knowledge dimensions model, the degree program learning outcomes convey into the revised Bloom's taxonomy 24 cognitive category levels. With the 24 knowledge dimensions model the degree program learning outcomes convey into the revised Bloom's taxonomy 24 cognitive category levels. According to this convey the curriculum learning outcomes will be standardized according to the Bloom's taxonomy. The 24 knowledge dimensions model mapping creation process begins with a table that listed the 24 learning outcomes categories, on the horizontal axis at the top and all the program courses listed across the vertical axis. The table cells identify which course addresses (satisfies) which learning outcome. Each course should be linked within at least one knowledge level and by entering cross sign at the relevant cell. Table 6 shows example of 24 knowledge dimensions mapping model.

Table 6: The 24 Knowledge Dimensions model.

Courses	**Learning Outcomes According to Revised Bloom's Taxonomy**																							
	Remembering				Understanding				Applying				Analyzing				Evaluating				Creating			
	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M	F	C	P	M
C101		X		x		x		x	x	x				x	x			x	x	x	x		x	x
C102			x		x		x		x	x	x		x	x	x	x			x	x	x	X		
C103			x	x	x	x		x	x	x	x	x	x				x	x			x	X	x	
:																								

7. THE 24 KNOWLEDGE DIMENSIONS MODEL ANALYSIS

To prove or disprove this research hypothesis; the 24 Knowledge Dimensions model (24KD) should be submitted to the same analysis approach, used with the seven standard templates for the purpose of comparison between them. The individual analysis of 24KD and the total number of Realized (R) are listed within Table 7. The total comparison result between the four standard models and the suggested model are illustrated in Figure 1. The total comparison results are 4 R from 4 for the 24KD model and

3 R as a higher score for the four standard models.

Table 7: The 24 Knowledge Dimensions Models analysis.

Comparison Feature	**The 24 Knowledge Dimensions model**
Bloom's Ranke	R
Clear	R
Informative	R
Internationality	R
Total Number of R	4

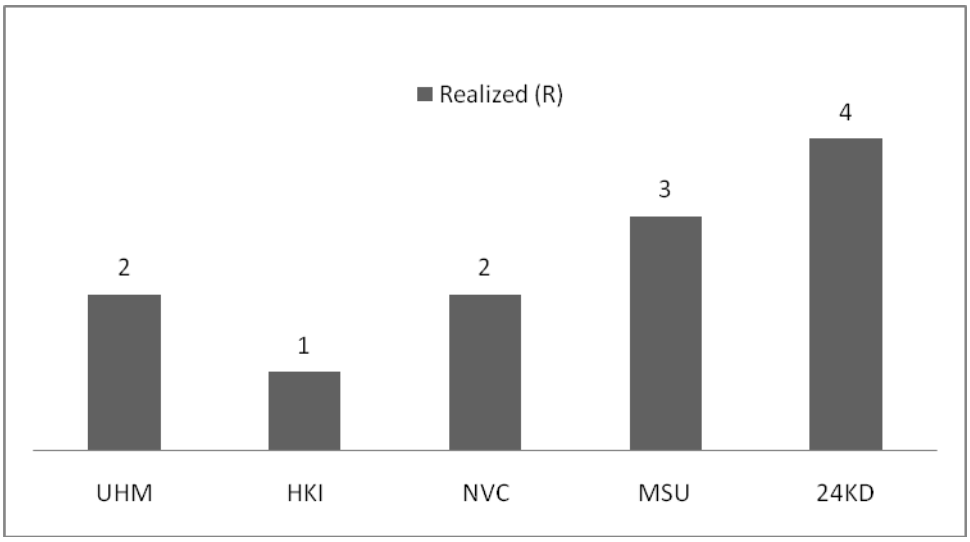

Figure 1. The four-model compared with 24KD.

8. CONCLUSIONS

To design an effective degree program, the higher education institution stockholders need to have a clear understanding of the learning outcome standards, that they are to educate and assess, and the capabilities of their students at the beginning and end of each course. That is, faculty members must define what learning outcomes the students have already learnt, and what mastery level they have earned, to design effective teaching, learning and assessment activities that integrate appropriately into the overall degree program sequence. To achieve these goals, learning outcomes mapping models are used to support the description of courses assessment and alignment, under the guidance of Bloom's Taxonomy for knowledge of levels.

Standard learning outcomes mapping models are very important for many purposes, such as the ability of comparing equivalent degree programs offered by different higher education institutions and for the sake of quality accreditation process. The total comparisons result from the previous section that shows that the 24KD model has higher grades than the four selected standard models and the 24KD model is more internationally orientated because it is customized and designed according to revised Bloom's taxonomy. Also, the suggested model determines and limits the academic degree programs learning outcomes into only 24 standard learning outcomes, classified under the revised Bloom's taxonomy which simplifies the comparison process between any equivalent academic degrees. According to the above results, the research hypothesis “The 24 Knowledge Dimensions model (24KD) according to revised Bloom's Taxonomy is more suitable for the higher educational institutions, as program accreditation learning outcomes mapping tool” is proven. The 24KD as a learning outcomes model are suitable, informative and robust. With more future researches the 24KD perhaps could be used to design academic degree curriculums in Oman’s higher education institutions

in order of unify and simplify the program accreditation process.

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