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Application of Bloom's Taxonomy in Categorization of Cognitive Process Development in Colleges

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Abstract
Bloom's Taxonomy is crucial in any teaching and learning environment because it determines direction for a course of study. This study assessed application of Bloom's Taxonomy in courses of study offered in colleges in Lusaka District. Objectives were: Assess the application of Bloom's Taxonomy in setting learning outcomes for the courses; Assess reflection of Bloom's Taxonomy in activities set for course participants; Ascertain significance attached to Bloom's Taxonomy in courses of study designed for participants. The study employed a mixed methodology, in particular employing a descriptive research design to assess application of the Taxonomy in course outcomes/objective. The population comprised college lecturers in Lusaka District. Sample size was 36 lecturers who were conveniently sampled. Data were collected using a questionnaire and analyzed using frequencies and Spearman correlation coefficient. Findings revealed that the majority of the lecturers did not illustrate how to use Bloom's Taxonomy in planning course of study, setting objectives/outcomes, creating learning activities or create assessment tasks for course participants. However, most of the lecturers demonstrated use of active verbs which they use in objectives/outcomes. Findings revealed that lecturers hardly used Bloom's Taxonomy. There is no relationship between lecturers' use of learning outcomes as a basis for preparing class tasks and their assertions that they compared objectives with tasks prepared for students. It is recommended that lecturers should be oriented on use of the learning Taxonomy.
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INTRODUCTION

Bloom's Taxonomy is an indispensable component in any teaching and learning activity. It classifies levels of cognitive development expected to be attained in various learning stages. Bloom's Taxonomy provides an understanding of how to formulate appropriate objectives in the teaching and learning process. This model also guides instructors to change complexity of the questions and help learners to achieve higher levels of hierarchy. Stanny (2016) explains the effectiveness of Bloom Taxonomy in classifying thinking skills in a hierarchy that ranges from lower level cognitive skills through higher order cognitive skills. Further, it helps in the development of critical thinking among teachers as they set assessment tasks. However, this taxonomy is hardly used in some of the teaching and learning processes. Attributed to this lack or partial application of the taxonomy is twofold. Firstly, lack of proper understanding of the taxonomy in using it to set objectives, questions, learning outcomes as well as corresponding assessments. Secondly, it is none exposure of teachers to application of taxonomy in the teaching and learning process. Akinboboye and Ayanwale (2021) affirm this disparity in the use of the taxonomy by some of the teachers who face challenges in using this taxonomy because of lack of complete understanding of how it is supposed to be applied. While some of the teachers have ideas in using the taxonomy, others have not been exposed to it at all. Such are problems associated to use of Bloom's Taxonomy among teachers. Earlier on, Gluga, Kay, Lister, Simon, and Kleitman (2013) confirmed that educators often need support from educational experts, which are not easily available in many departments in higher education. It was against this background that this study was conducted to assess the application of the Taxonomy among lecturers in colleges.

LITERATURE REVIEW

The Bloom's Taxonomy Model is helpful to the teachers for thinking and analyzing their teaching and student's learning. The framework is used to state clear objectives which can help the teachers to plan lessons accordingly. It also provides a framework for cognitive behaviors which can be applied to understand difficulty of tasks, conduct an assessment, and simplify or complicate the activities for students (Armstrong, 2010).

However, not all teachers know how to use Bloom's Taxonomy in preparing activities for their learners. Larson & Lockee (2019) explain that educators often find it challenging and tedious to develop learning objectives to describe cognitive skills at different levels of Bloom's taxonomy.

Li et. al. (2022) observed that some educators have difficulties in creating learning objectives applicable to the levels in Bloom's taxonomy. They further indicated the need to reflect objectives in the advancement of learners' skills with learning content as well as dependencies the concerning set intents. Similarly, Masapanta-Carri´on & Vel´azquez-Iturbide (2018), Mpolomoka, Banda & Dube (2017) and Mpolomoka, Muyangana, Banda, Dube, Mabenga, Kangwa & Muyoba (2016) observe difficulties that educators have in developing learning objectives appropriate to the levels specified in Bloom's taxonomy. Teachers mostly make the mistake of assuming that learners who can remember facts can then also complete those more important higher order tasks. This partial understanding of the taxonomy limits cognitive development of learners because of lack of exposure to use of higher order thinking skills.

Masapanta-Carrión, Velázquez-Iturbide & Ángel (2018) note another dimension of difficulties that teacher experience which relate to challenges faced in classifying content into specific levels of the taxonomy. Over dependance on acquisition of low level cognitive development knowledge and skills at the expense of higher level ones in teaching is problematic. The taxonomy is partially utilized which adversely affects development, intellectually. Some teachers were seen to have limited understanding of terminologies applicable in each level of the cognitive taxonomy. Masapanta-Carrión, Velázquez-Iturbide & Ángel (2018) propose to offer training to instructors in how to use it was proposed as a way of solving the problem of deficient use of the taxonomy. Furthermore, Akinboboye & Ayanwale (2021) urge teachers to set questions that based on Bloom's taxonomy to ensure balancing cognitive skill development in learners.

Bloom's Taxonomy classifies learning into stages which range from the lowest to the highest levels. Adam (2015) explains that the taxonomy contains six categories of cognitive skills ranging from lower-order skills that require less cognitive processing to higher-order skills that require deeper learning and a greater degree of cognitive processing. It indicates these consecutive learning levels which are planned for learners to experience. A set of three hierarchical models is used to classify educational learning objectives into levels of complexity and specificity. The three lists cover the learning objectives in cognitive, affective and sensory domains. The cognitive domain list has been the primary focus of most traditional education and is frequently used to structure curriculum learning objectives, assessments and activities (Anderson et al, 2001). These levels can be helpful in developing learning outcomes because certain verbs are particularly appropriate at each level and not appropriate at other levels (though some verbs are useful at multiple levels).

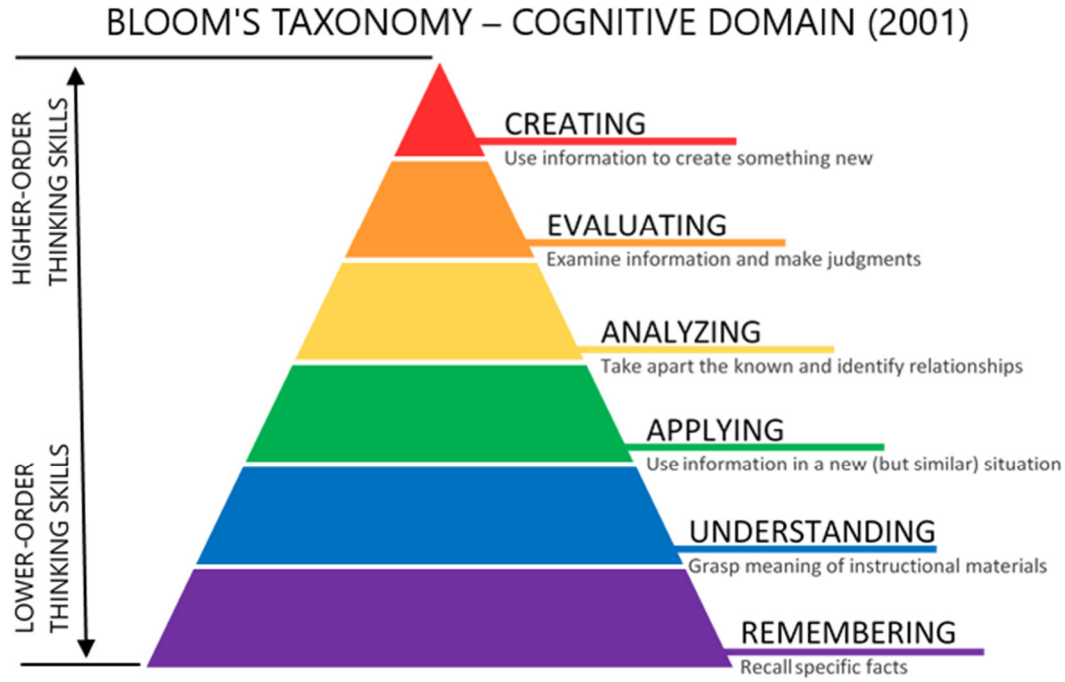

Figure 1: Bloom's Taxonomy Cognitive Domain
Source: Anderson (2001).

Bloom's Taxonomy leads to deeper learning and transfer of knowledge and skills to a greater variety of tasks and contexts (Adam, 2015). Levels of development in the cognitive domain are ordered from simple to complex in terms of thinking skills. Each level is defined and suitable verbs for learning outcomes are illustrated.

Table 1: Bloom's Taxonomy Cognitive Domain

Level	Definition	Suitable Outcome Verbs
Remember	Retrieve, recall, recognize	Cite, define *Cite, define, describe, identify, label, list, match, name, outline, quote, recall, report, reproduce, retrieve, show, state, tabulate, and tell.*
Understand	Demonstrating comprehension through different forms of explanation.	*abstract, arrange, articulate, associate, categorize, clarify, classify, compare, compute, conclude, contrast, defend, diagram, differentiate, discuss, distinguish, estimate, exemplify, explain, extend, extrapolate, generalize, give examples of, illustrate, infer, interpolate, interpret, match, outline, paraphrase, predict, rearrange, reorder, rephrase, represent, restate, summarize, transform, and translate.*
Apply	Use information or a skill in a new situation	*Apply, calculate, carry out, classify, complete, compute, demonstrate, dramatize, employ, examine, execute, experiment, generalize, illustrate, implement, infer, interpret, manipulate, modify, operate, organize, outline, predict, solve, transfer, translate, and use.*
Analyze	Break material into its constituent parts and determine how the parts relate to one another and/or to an overall structure or purpose	A*nalyze, arrange, break down, categorize, classify, compare, connect, contrast, deconstruct, detect, diagram, differentiate, discriminate, distinguish, divide, explain, identify, integrate, inventory, order, organize, relate, separate, and structure.*
Evaluate	Make judgments based on criteria and standards	*Appraise, apprise, argue, assess, compare, conclude, consider, contrast, convince, criticize, critique, decide, determine, discriminate, evaluate, grade, judge, justify, measure, rank, rate, recommend, review, score, select, standardize, support, test, and validate.*
Create	Put elements together to form a new coherent or functional whole; reorganize elements into a new pattern or structure	*Arrange, assemble, build, collect, combine, compile, compose, constitute, construct, create, design, develop, devise, formulate, generate, hypothesize, integrate, invent, make, manage, modify, organize, perform, plan, prepare, produce, propose, rearrange, reconstruct, reorganize, revise, rewrite, specify, synthesize, and write.*

Table 1 above summarizes the cognitive domain, its levels and applicable behavioural verbs. Illustrated in the table, is the incremental learning that builds intellectual capacity of learners. Blooms taxonomy produced according to Nkhoma (2016) desired effects of incremental learning. Thus, Bloom's taxonomy highlights the need for including learning objectives that require higher levels of cognitive skills that lead to deeper learning and transfer of knowledge and skills to a greater variety of tasks and contexts (Adam, 2015).

Blooms taxonomy is indispensable to teaching and learning. It provides guidance on segmenting learning abilities expected to be achieved in each level. It is incremental because the levels are progressive from low to high in terms of cognitive development. For this reason, teachers at all levels are supposed to be acquainted with knowledge and skills in how to apply the cognitive domain in their teaching. Reviewed literature shows that there some knowledge gaps in the use of the taxonomy. While some teachers partially know how to use the taxonomy, others are bereft of the required knowledge.

Statement of the problem

Preparation of education activities is guided by models. Bloom's Taxonomy is one of the models which underly creation of courses of study in terms of setting learning outcomes, objectives, topical activities and suitable tasks. Not all course instructors/lecturers are conversant with the use of Bloom's Taxonomy. Absence of Taxonomy result in, course, outcomes/objectives, activities and materials being mismatched and in worse cases, underteaching course participants. It was not known how much lecturers acquainted themselves with the right Taxonomy for developing appropriate cognitive processes for the learners in the colleges. This study therefore investigated the application of bloom's Taxonomy in categorization of cognitive process development in colleges in Zambia.

1) Assess the application of Bloom's Taxonomy in setting learning outcomes for the courses;
2) Assess reflection of Bloom's Taxonomy in activities set for course participants;
3) Ascertain significance attached to Bloom's Taxonomy in courses of study designed for participants.

Hypotheses Testing

HO_1 - There is no relationship between use of objectives and learning outcomes in tasks prepared.

HO_2 - Use of Bloom's Taxonomy in designing study courses was not associated to grouping of objectives when preparing lecture notes.

Theoretical Framework

This study used Objectives-Oriented Evaluation Approach which focuses on determining the extent to which the purposes of a program are achieved. The objectives-oriented approach to evaluation is attributed to Ralph W. Tyler (1942, 1950) who conceptualized and popularized the focus on objectives in education. According to Tyler (1942) the goals and the objectives of a program must be defined as a prerequisite to evaluation. The objectives-oriented evaluation determines whether some or all of the program objectives are achieved and, if so, how well they are achieved. In education, the objectives are concerned with the purposes of a single lesson or training program or the knowledge students should attain during an entire year. Worthen and Sanders (1987) assert that objective-oriented approach is systematic, logical, scientifically acceptable and ready to use by evaluator. This study adopted objectives-oriented approach based on the assumption that objectives provide accurate and reliable information about the insights of the programme. The focus of this study was confined to objectives/questions and learning outcome statements of the program in relation to cognitive domain in Bloom's Taxonomy. Focus was on the application of goals, objectives and intended outcomes of a program. The major question addressed in this kind of evaluation is.

METHODOLOGY

The study employed a mixed methodology in which a concurrent design was used to allow for collection of two types of data at the same time. A descriptive research design was used to assess application of the taxonomy in course outcomes/objective. Population targeted comprised college lecturers in Lusaka District. Convenience sampling was used to get the required sample of 36 respondents.

Data were collected using a self-administered questionnaire containing closed and open-ended statements. The closed-ended part constituted the quantitative aspect of the study and it had 14 statements. Six statements dichotomous with a 'yes' or 'no' response. The remaining eight had Likert scale which was used to measure lecturers' opinion towards use of objective and Bloom's Taxonomy in their courses of study. Qualitatively, the other segment comprised open-ended statements. They are textual responses and generally used for qualitative analysis (Banda, Mpolomoka, Mbono & Sampa, 2017). The first part of the questionnaire comprised question items that assessed use of objectives. The second part assessed application of objectives and Bloom's Taxonomy in implementation of course studies. Bloom's Taxonomy underlies determination of objectives or learning outcomes for any lesson prepared for students. Close-ended part was quantifiable, analyzed using Spearman coefficient whereas the open-ended was thematically analyzed.

Data were analyzed using frequencies for computing statistics for responses obtained from lecturers. Spearman rank correlation coefficient was applicable in analyzing relationship between variables concerning use of Bloom's Taxonomy in preparing courses of study among lecturers. Therefore, we believe that the study would generate reliable data since it employed standardized and scientifically-accepted data collection tools.

FINDINGS

Findings are presented following key thematic areas derived from the objectives and the emerging issues.

The majority of the lecturers assessed showed that they hardly applied the sub-domains for ascertaining the type of suitable objective. Spearman coefficient correlation was used to analyze association of variables reflecting application of objectives, learning outcomes and tasks inherent in the courses of study lecturers offered in colleges. The findings showed weak correlations between the tested variables of interest.

Application of Bloom's Taxonomy in Setting Learning Outcomes

Lecturers did not always apply Bloom's Taxonomy when setting objectives for their teaching and learning notes. Notably, objectives were set according to the order of grasping knowledge and skills, cognitively. Evidently, verbs used in the objectives were sourced from the same level of the cognitive domain. Responses from participants in the study indicated non-compliant to application of Bloom's Taxonomy in grouping objectives. Domains were not stated in the expression of their understanding of grouping objectives.

Application of Bloom's Taxonomy in Setting Objectives

Course lecturers indicated that they always grouped objectives when preparing lecture notes. Lecturers agreed that they used Bloom's Taxonomy in setting objectives/outcomes. They agreed that they grouped objectives from simple to complex.

Most of the lecturers demonstrated use of active verbs when setting learning outcomes. They applied active

verbs in objectives which they set for their lecture notes. They indicated that they always grouped objectives according to the applicable verbs in the given lessons.

Reflection of Objectives

Lecturers varied in the way they grouped objectives for their notes. The majority of the lecturers showed that they did not group the objectives in any way. Objectives were set without following any format. A few who grouped their objectives indicated that they used the order of simple to complex or vice versa. Out of 36 lecturers, two showed that they grouped objectives using Bloom's Taxonomy through application of sub cognitive domains which are: Remembering, understanding, applying, analyzing, evaluating, creating.

Grouping of objectives into lower and higher thinking skills varied among lecturers. While some of them followed the given order, others did not. Notably, out of 36 lecturers, 20 showed how to group objectives into lower to higher order thinking skills. Sixteen were not sure of how to group the objectives.

Application of Bloom's Taxonomy in Designing Courses

The majority of the lecturers showed that they used theoretical framework to guide them in grouping of learning outcomes for their courses. Responses from lecturers indicated conflicting views on the use of Blooms' Taxonomy when setting learning outcomes. The majority of the lecturers indicated that they always used the Taxonomy to design study courses.

However, when asked to show the domains they used in the Taxonomy, not all of them demonstrated the required cognitive levels. Out of the 36 lecturers, seven expressed all the correct levels, 10 partially did whereas the majority, 19 of them exhibited ignorance of the sought Bloom's Taxonomy.

The majority of the lecturers did not illustrate how to use Bloom's Taxonomy in planning course of study, setting goals/objectives, creating learning activities or create assessment tasks for course participants. Of the 36 lecturers, three showed how to apply the cognitive levels in one of the given areas. The rest, 33 of them did not. This corroborates with what empirical literature reveals regarding cognitive-reflective engagements and the recommendation to enhance learning outcomes to mirror the revised Bloom and Solo's Taxonomies (Simui, Mpolomoka, Sakakombe & Mhango, 2020; Garrison, Anderson & Archer, 2001).

The lecturers indicated that they used Bloom's Taxonomy partially in their handling of course of study delivery. While many of the lecturers found it useful in setting objectives, others used the Taxonomy to assess the teaching and learning process.

Hypotheses Testing

Table 2: Relationship Between Objectives and Learning Outcomes in Tasks

There is no relationship between use of objectives and learning outcomes in tasks prepared.

Correlations

			I use learning outcomes as a basis for preparing tasks for the class	I compare objectives with tasks prepared for students
Spearman's rho	I use learning outcomes as a basis for preparing tasks for the class	Correlation Coefficient	1.000	.187
		Sig. (2-tailed)	.	.274
		N	36	36
	I compare objectives with tasks prepared for students	Correlation Coefficient	.187	1.000
		Sig. (2-tailed)	.274	.
		N	36	36

Table above on Spearman rho r. .187 which shows the relationship between use of learning outcomes as a basis for preparing tasks and objectives prepared for students. The result of the analysis, r. .187 is indicative of a very weak relation between the variables. This means that lecturers' use of learning outcomes as a basis for preparing learning tasks relate to their assertions of comparing objectives with tasks prepared for students was indicative of a weak relationship.

The *p*- value less than the significance level ($\alpha = 0.01$) for any correlation coefficients can reject the null hypothesis, and the correlation coefficients are considered statistically significant with 99% confidence level. The p-value of .274 shows that the variables are uncorrelated because it is more than .01. We therefore fail to reject the null hypothesis that there is no relationship between lecturers' use of learning outcomes as a basis for preparing tasks for the class and their assertions of comparing objectives with tasks prepared for students.

Table 3 Objectives and Learning Outcomes

Correlations

			I group objectives when preparing lecture notes	I use learning outcomes as a basis for preparing tasks for the class
Spearman's rho	I group objectives when preparing lecture notes	Correlation Coefficient	1.000	.305
		Sig. (2-tailed)	.	.071
		N	36	36
	I use learning outcomes as a basis for preparing tasks for the class	Correlation Coefficient	.305	1.000
		Sig. (2-tailed)	.071	.
		N	36	36

Table 3 above on Spearman rho r. .305 shows the relationship between grouping objectives when preparing lecture notes and use of learning outcomes as a basis for preparing tasks for the class. The result of the analysis indicates that r. .305 falls between .20 and .39 which is verbally interpreted as weak. This means that there was a weak association of lecturers' grouping of objectives when preparing lecture notes and use of learning outcomes as a basis for preparing tasks for the class.

The *p*- value of less than the significance level ($\alpha = 0.01$) for any correlation coefficients can reject the null hypothesis, and the correlation coefficients are considered statistically significant with 99% confidence level. The p-value of .071 shows that the variables are uncorrelated because the p-value of.187 is more than .01. We therefore fail to reject the null hypothesis that there is no relationship between grouping objectives when preparing lecture notes and use learning outcomes as a basis for preparing tasks for the class among lecturers.

Use of Bloom's Taxonomy in designing study courses was not associated to grouping of objectives when preparing lecture notes.

Table 4: Bloom's Taxonomy and Objectives

Correlations

			I use Bloom's Taxonomy to design study courses	I group objectives when preparing lecture notes
Spearman's rho	I use Bloom's Taxonomy to design study courses	Correlation Coefficient	1.000	.282
		Sig. (2-tailed)	.	.095
		N	36	36
	I group objectives when preparing lecture notes	Correlation Coefficient	.282	1.000
		Sig. (2-tailed)	.095	.
		N	36	36

Table above shows Spearman rho r. .282 which is about the relationship between use Bloom's Taxonomy in designing study courses and grouping objectives when preparing lecture notes. The result of the analysis, r. .282 falls between .20 and .39 which is verbally interpreted as weak. This means that there was a weak correlation between lecturers' use Bloom's Taxonomy in designing study courses and grouping objectives when preparing lecture notes.

The *p*- value of more than the significance level ($\alpha = 0.01$) for any correlation coefficients is considered statistically insignificant with 99% confidence level. The p-value of .095 shows that the variables are uncorrelated because it is more than .01. We therefore fail to reject the null hypothesis that there is no relationship between use Bloom's Taxonomy designing study courses and grouping objectives when preparing lecture notes among course lecturers.

The hypothesis tests conducted showed results indicative of weak relationships among variables. Lecturers' application of Bloom's Taxonomy in their preparation of teaching and learning activities was insignificant manifested. The cognitive Taxonomy was not used as a basis for determining content of study courses neither were objectives used for ascertaining lecture notes. This revelation is contrary to the finding by Nkhoma, et al., (2017) which report on application of Bloom's Taxonomy in music education as a framework for aligning learning objectives, curriculum and assessment.

DISCUSSIONS

Lecturers' responses were inconsistent in their use of Bloom's Taxonomy depending on the nature of the

assessment given. They showed agreement in most parts of the questionnaire which needed a yes/no response. However, when asked to show the domains if they used the Taxonomy, not all of them demonstrated the required cognitive levels. Most of the lecturers did not show the application of the Taxonomy when asked to illustrate. Agreeing with the use of the Taxonomy and showing its applicability, did not correlate. The lecturers agreed to what they did not know which means they did not know the Taxonomy and its application in their work.

Despite agreeing that they used Bloom's Taxonomy in their teaching and learning activities, lecturers failed to illustrate how they applied it in the preparation of courses and lecture notes. Lecturers varied in the way they grouped objectives for their notes. While some of them followed a format from simple to complex, others grouped them without any format followed. The majority of the lecturers showed that they did not group the objectives in any way.

Although lecturers agreed that they used the Taxonomy, most of them failed to demonstrate the application of the required cognitive levels. The majority of the lecturers assessed showed that they hardly applied the sub-domains for ascertaining the type of suitable objectives. Responses from many of the participants in the study indicated non-compliant to application of Bloom's Taxonomy in grouping objectives. Domains were not stated in the expression of their understanding of grouping objectives. The majority of the lecturers did not illustrate how to use Bloom's Taxonomy in planning course of study, setting goals/objectives, creating learning activities or create assessment tasks for course participants. Chandio, Pandhaini & Igbal (2016) attest to failure to apply Bloom's Taxonomy to lack of training of people involved in handling the cognitive domains levels.

Some of the lecturers indicated that they used Bloom's Taxonomy partially in their handling of course of study delivery. Lecturers' use of learning outcomes as a basis for preparing did not relate to their assertions of comparing objectives with tasks prepared for students. The researchers failed to reject the null hypothesis that there is no relationship between lecturers' use of learning outcomes as a basis for preparing class tasks and their assertions that they compared objectives with tasks prepared for students. This means that lecturers did not use Bloom's Taxonomy to design study courses and grouping objectives when preparing lecture notes.

This study contributes to strengthening the use of taxonomies as bases for preparing courses and lecture notes. This is because Bloom's Taxonomy is termed as a pathway that guides the learning process.

CONCLUSION

Lecturer's affirmation that they used objectives and Bloom's Taxonomy in preparatory activities of their courses was inconsistent with textural responses and tested hypotheses. There was no relationship in the lecturer's use of Bloom's Taxonomy when preparing study courses and grouping of objectives for lecture notes. There is no relationship between lecturers' use of learning outcomes as a basis for preparing class tasks and their assertions that they compared objectives with tasks prepared for students.

Lecturers should prepare courses of study and learning activities that include all cognitive levels in the domain. This is because Bloom's Taxonomy should serve as a basis for setting objectives and related activities.

RECOMMENDATION

There is need to orient college lecturers on the importance of use of learning objective and outcomes based on known models of which Bloom's Taxonomy is one. This can be done through in-house trainings and other staff development processes.

Suggestions for further Study

There is need for a research in determining application of verbs used in cognitive domain in programmes offered in colleges.

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