Review

Makale Başvuru/Kabul Tarihleri
Received/Accepted Dates
03.11.2020/13.12.2020

Journal Social Research and Behavioral Sciences
Sosyal Araştırmalar ve Davranış Bilimleri Dergisi
ISSN:2149-178X

Volume: 6 Issue: 12 Year: 2020

Analysis of Non-Parametric Qualities of Undergraduate Biology Examination Questions in a Nigeria University: Implications for Quality Assurance and Students' Learning Outcome Tajor Ago?

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Abstract

This study was carried out to ascertain non-parametric qualities of past undergraduate biology examinations questions in one Nigeria university. The study employed ex-post facto research design and involved document analysis procedure. It surveyed one hundred and seven examination question papers with a total One thousand one hundred and ninety eight mainly essay and sub-essay questions for a period of five years examination sessions from 2012/2013 to 2017/2018 but excluded 2016/2017. Using descriptive content analysis method, the study analysed the content validity and the cognitive content of the biology examination papers. Descriptive statistics, mainly percentage was used to determine the proportion of the questions set on the content of each course in context of the National Universities Commission (NUC), Abuja, Nigeria, Benchmark for Minimum Academic Standard (BMAS, 2007) and the in-use university academic prospectus undergraduate biology curriculum. The analysis revealed that 80% of the content of the biology curriculum was tested but the examination tested more of lower order cognitive abilities (knowledge and comprehensive) which constituted 76.11% with deviation +36.11, than higher order questions (23.85%) with application/problem solving constituting only1.83% The overall finding calls for further improvement in the qualities of the examination questions. Appropriate recommendations that could lead to improvement of the content validity of the examinations questions, increasing proportion of problem solving/application and broad range of higher level analytical, creative and evaluative thinking questions were made. It was concluded that the examination question papers could be considered suitable assessment tool that satisfy content validity but low towards the attainment of higher cognitive objectives of biology of the undergraduate program.

Keywords: Non parametric qualities, biology examination questions, quality assurance, students learning

Introduction

At all levels of education, assessment is used as one of the means or mechanism of quality assurance. Traditionally, assessment is a means or process of finding out what students have gained in terms of knowledge, skills and attitudes acquired from what has been taught In any school or academic system, the quality of test or examination questions used for assessment dictates the quality of the educational system, the quality of awards and the certificate obtained (IBBU QA Framework of educational Processes, 2017) and to a greater extent what skills students have acquired. The qualities of examination questions have long been issue of concern (Oluoch, 2014; Hamafyelto; Hamman-Tukur & Hamafyelto**,** 2015). Studies have also revealed that low quality questions are a common feature of examination in the Nigeria universities. Hamman-Tukur and kamis, 2000, Mustapha, 2013; Hamafyelto, Hamman-Tukur and Hamafyelto, 2015). Lower order questions keep the students at low level thinking; to recall facts and figures rather than at the ability level to think beyond what they are taught, and be able to apply their knowledge to novel life and problem solving situations which are the hallmarks of university education. World Bank report No. 124 (1999/2000) attributed sub-quality and standard of students graduating in many African countries to quality of assessment. It is generally reported that most graduates leave university lacking critical and problem solving intellectual skills. Consequently, this is affecting the quality of students' learning, the quality of students' graduating from the system, and the quality of awards and certificates (Oluoch, 2014).

Hence, students need to be engaged in higher order cognitive learning activities in the learning situations and teachers are required accordingly to incorporate high order questions in their assessment of students learning. Although there few studies on evaluation of examination questions at university level in Nigeria, the several studies at nationally and internationally levels have however consistently reveal that most of the questions focus on assessing lower thinking skills (Hamman-Tukur and Hamafyelto, 2015; Swart,2010, Abduh, 2020). This study was specifically undertaken to ascertaining the quality of examination questions being used in the assessment of biology at university level with the view that the finding might be different from the previous studies. It specifically focus on the content validity of biology examination questions and the cognitive level coverage of the questions of a B.Sc. biology programme in a University in Nigeria as a case study. It is a 5-year longitudinal study beginning from 2012/2013 to 2017/2018. Non-parametric quality of test items or examination questions is define in the context of this study in terms of validity; describing the scope of content coverage, and the cognitive domains characteristics of the examination questions.

Purpose of the Study

The purpose of this study is to establish the non-parametric qualities inherent in undergraduate biology examination test items over a five year study. Specifically, this study is guided by the following objectives;

i. To ascertain the content areas of the sampled undergraduate biology courses that was covered by the examination questions. This is to determine the content validity of the examinations questions.
ii. To determine the cognitive demands of the test items in context of stated or implied cognitive objectives of study of biology at the university level.

iii. To find out the proportion of lower to higher cognitive demands of the examination questions.

Research Questions

The study attempted to provide answers to the following research questions;

i. What percentage of the content areas of undergraduate BSc biology courses is covered by the biology examination questions?
ii. What cognitive levels are tested by the examination questions?
iii. What proportions of lower to higher order cognitive objectives are measured by the examination questions?

Conceptual and Theoretical Framework

Biology is one of the science programmes being offered at the university level of education in Nigeria. Biology is a subject that is generally described as the science of life. It involves the study of living organisms including their structure, function, growth, evolution and distribution. Basically, the study of biology is divided into ***Botany*** and ***Zoology.*** The Benchmark Academic Standard (BMAS) for biology published by the National Universities Commissions (NUC), Abuja (FGN, 2007) prescribed biological science courses and contents to be offered at the Nigerian university undergraduate level. The essential components of the biology undergraduate curriculum include courses in botany and zoology and general biology covering the various divisions of biological sciences including microbiology and biochemistry.

The objectives of studying biology at the University level are to provide students:

i. a broad balance biological sciences knowledge and skills
ii. the ability to apply knowledge and skills of solving theoretical and practical problem.
iii. the knowledge and skill base from which they can proceed to further studies in specialized areas of biology or multi- disciplinary areas involving biology.
iv. through training and orientation, an appreciation of salutary reward of inter–and multi–disciplinary approach to the solution of complex life problems,
v. the enthusiasm for biology, and appreciation of its application in different context and to involve them is an intellectually stimulating and satisfying experience of learning and studying (FGN, BMAS, Science, 2007).

Furthermore, students are expected to develop through the study of biology cognitive skills and competences in:

i. Planning and executing experiments or practical work
ii. Use of apparatus and techniques
iii. Analysis (e.g., relationships among variables; cause and effect
iv. Synthesis (e.g., formulating generalizations and conclusion, developing procedures).
v. Classifying (requiring both analysis and synthesis)
vi. Mathematical (e.g. computation, graphic, interpolation, extrapolation)
vii. Evaluation (e.g. critical thinking in regard to interpretation of data and testing hypotheses; assessing the limitations of knowledge in relation to data).
viii. Application of knowledge to new situations and to entrepreneurship, and
ix. Adoption of ICT as learning tool.

Assessment is an integral of teaching and learning process which should help to measure the learning outcomes in the context of the above stated objectives. Assessment serves the means

of ensuring standards and quality of an educational system and educational outcomes. Test or examination questions are common instruments of assessment used by teachers to collect, measure, determine, deduce and report in qualitative and quantitative terms information about students' learning progress in terms of knowledge, skills and value acquired as outcomes learning. Essentially, test or examination questions are supposedly used to stimulate or to prompt students thought processes, exert them cognitively and thereby elicit responses (Williams and Buseri, 1986; Swart, 2010), Also examination or test questions should engage students in a task on problem solving that could promote critical thinking; divergent thinking, and authentic reasoning, and to demand students to have thoughts and perceptions that are beyond mere knowledge recall (Malmfors, 2006;Amua-Sekyi, 2016). The degree of students' engagement in these thought process depends on the cognitive levels of the questions (Williams and Buseri, 1986; Swart, 2010).

Similarly, the culture of questions used for assessment influences greatly the quality of students learning, their study habits and how they seek and how they cognitively process information, synthesize knowledge, and the possibilities for applying the acquired knowledge and skills (Amua-Sekyi, 2016). Examination questions that mainly focus on recall of factual knowledge will elicit surface learning by which students primarily learn to memorise and recall facts and details from lecture or text and are engaged in low level intellectual processing of knowledge (Scouller, 1998) (Malmfors, 2006; Swart, 2010). Conversely, if assessment involves using questions that demand students being engaged in high level intellectual processing, students will likely employ deep learning strategies in their study. Deep learning is characterised by students who attempt to relate ideas together, to construct their own meaning from what is taught, think critically and capable of applying what is learnt to solve novel problems. Hence examination questions should exert students not only to demonstrate knowledge understanding but also to apply what they have learnt to other context, stimulate high order thinking and problem solving skills (Amua-Sekyi, 2016).

In order to achieve valid assessment, the use of standard and quality test or examination questions are required. Examination questions should align with the content and objectives of the course taught as a measure of content validity. Examination questions should therefore represent all the range of possible learning units the examination or test should cover and be found suitable to measure the stated or implied objectives of a particular course (Busari, 1986; Mustapha, 2000; Hamafyelto, Hamman-Tukur & Hamafyelto, 2015; Amua-Sekyi, 2016).

Development of quality examination questions has often follows the principles of validity and reliability, and the theoretical founded model of Blooms cognitive categorisation. The Blooms cognitive classifications are; knowledge recognition, comprehension, application, analysis, synthesis and evaluation. These classifications have continuously guide teachers and researchers when developing or evaluating test items (Mustapha, 2013; abduh, 2020)

Perrot (1982), Swart (2010) and Amua-Sekyi (2016) grouped questions based on the Bloom's classified cognitive levels into lower-order and higher order. The lower order questions evoke remembering of specific facts and comprehension of information. The higher-order questions evoke higher-order thinking such as, applying, analyzing, synthesizing and evaluating information.

Reference to the nature of science and objectives of science teaching, test questions should align with assessment of cognitive skills and abilities that demands students to explaining, interpreting, translating information from one form to another; interpreting information from

graphs, tables and charts; and application of scientific ideas, concepts, observations, phenomena, laws, theories and procedures; analysing and deducing patterns and relationships from experimental or other data to solve qualitative and quantitative problems. In framing questions, the teacher should use appropriate words that will exert students to think at the different cognitive levels as classified by Bloom and in context of scientific knowledge and skill domains.

The IBB University assessment policy stipulates the following standards and outlines range of specific action verbs to stating examination questions;

- Questions set shall cover all the course contents
- Questions set shall be distributed to cover the blooms cognitive taxonomy in the following proportion across level;

	Bloom's Taxonomy	
Examination level	Low level cognition; Comprehension	Higher level cognition Application and critical thinking
100L	60%	40%
200L	50%	50%
300L	40%	60%
400L	30%	70%

The key verbs in the framing of examination questions for different cognitive levels;

Level 1: Knowledge: ability to exhibits previously learned material by recalling facts, terms, basic concepts and answers.

Key words: State, describe, identify, label, list, define, locate, name, outline, select, reproduce, what, who, where, when, which, choose, find, how, define, show, spell, match, name, relate, tell, recall.

Level 2: Comprehension: involes demonstrating understanding of facts and ideas by organizing, comparing, translating, interpreting, giving descriptions and stating main ideas.

Key words: Classify, explain, convert, describe, give example, paraphrase, rewrite, summarize, extend, estimate, rephrase, demonstrate, interpret, illustrate, infer, relate, translate, show, etc.

Level 3: Application: involves solving problems by applying acquired knowledge, facts, techniques and rules in a different way.

Key **words***:* Apply, change, classify, compute, compare, employ, illustrate, discover, modify, relate, solve, support, predict, build, choose, construct, develop, make use of, organize, experiment with, plan, select, utilize, model.

Level 4: Analysis: involves examining and breaking information into parts by identifying motives or causes, making inferences and finding evidence to support generalizations.

Key words: Analyse, breakdown, determine evidence, use diagram, select, distinguish, identify, discriminate, differentiate, infer, illustrate, relate, point out, outline.

categorize, classify, compare, contrast, discover, examine, inspect, simplify, survey, list, relationships, function, infer, motive, etc.

Level 5: Synthesis: involves compiling information together in a different way, combining elements in a new pattern or proposing alternative solutions.

Key words: Synthesise, categorise, combine, compose, compile, create, develop, device, design, generate, modify, organize, plan, predict, produce, rearrange, reconstruct, revise, summarize, write, build, combine, compile, compose, construct, create, design, develop, estimate, formulate, imagine, invent, make up, originate, plan, predict, propose, solve, suppose, discuss, modify, change, improve, adapt, minimize, maximize, theorize, elaborate, test, improve,

Level 6: Evaluation: involves presenting and defending opinions by making judgments about information, validity of ideas or quality of work based on a set of criteria.

Key words: Argue, appraise, assess, conclude, contrast, criticize, decide, discriminate, evaluate, justify, interpret, support, compare and contrast, choose, defend, determine, dispute, evaluate, judge, measure, compare, rate, recommend, select, agree, prioritize, opinion, support, importance, criteria, prove, disprove, perceive, value, estimate, influence, deduct.

This study therefore attempt to provide evidence on above features of biology examination questions and invariably the implementation of the assessment policy of the university.

Research Method

Research Type

This study employed the ex-post facto descriptive research design which involves content analysis for data sourcing. In this context, quality analysis of five years biology examination questions in terms of the extent of coverage of the content of the in-use biology curriculum of the University, and their percentage distribution based on Blooms cognitive categorisation was carried out to ascertaining the quality of assessment questions.

Sources of Data

The sources of data for this study were the undergraduate 2012/2013 to 2017/2018 academic session (first and second semesters) biology examination question papers and the BMAS (NUC, 2007) biology curriculum and the 2011-2016 academic prospectuses for B.Sc. biology of the university. Convenience sampling was employed in the selection of the examination papers based on the question papers that were readily available in the examination record of the biology department. The data excluded the 2016/2017 examination question papers as were not readily available at the time of this research

Procedure for Data Collection

Firstly, analysis of the contents BMAS of the NUC biology curriculum and the university academic prospectus to identify the divisions/courses and their contents, the number of topics and the content units that make up the curriculum. The analysis revealed the conceptual structure of the curriculum based on the course titles/major themes from which major topics and content units were derived and described in terms of the of the biological concepts,

principles, laws and theories which cover botany and zoology, general biology and other biological sciences; microbiology and biochemistry contents.

Secondly, the Biology question papers for the 5-year sessions were taken and examined and the questions classified into major divisions/themes/topics of the curriculum. Each paper contains an average of 4 or 5 essays questions based on the credit load of the courses. Sub questions under the essay questions were counted as whole question for the purpose of this study in each case. On the whole, there are 107 biology examination questions papers consisting of 1198 questions or test items based on 26 courses at 200, 300 and 400 level available to the researcher. The test items were examined for contents in which they were derived, the content coverage and the cognitive content of the biology curriculum tested. Using a table of specification as a guide, the test items were classified under the course titles; the number of test items per course contents/topics, and the cognitive level of the test items guided by key words for framing questions at different cognitive levels were recorded accordingly. A two level cognitive categorization; lower order (knowledge and compression)xand higher order (consisting of application, analysis, synthesis and evaluation questions) was adopted (Mustapha, 2000 & 2013; Swart, 2010; Abuduh, 2020**)**

Reliability of Data Collection

The following reliability procedures were followed for data collection;

The course title of each of the question paper was aligned with the BMAS listed course titles and the in use biology curriculum of the university. The course description and content/number of topics in the curriculum were listed while relating that to the topics/content areas examined. Examined content areas were marked with a stroke for each of the content areas and counted. This was done until constant numbers were obtained thrice consecutively.

Guided by lists of words/phrases in the literature (NITESP, 1993; Mustapha, 2013; (IBBU QA Framework of educational Processes, 2019) a comprehensive framework was evolved and used as a guide for the cognitive categorization of the question items from each of the question papers by the researcher. For the cognitive classification of the test terms, intra-subjective consistency was sought by categorizing the items until the categories remained same thrice consecutively.

The categorization was presented to a Professor of science education with specialization in biology education to help validate the classifications. The items were found to be properly classified in most of the cases while few cases were reviewed.

Data Analysis and Findings

The data collected for both content coverage of the examinations and the cognitive categorization of the questions was analysed based on the objectives of this study and in context of Bloom's cognitive categorisation. Descriptive statistics involving mainly percentages was used for the analysis.

The summary of the analyses and findings are given in tables 1 to 7

Table1. Summary of content coverage and percentage weights of set questions on the major divisions (2013/2014 -2016/2017

Proportions of major divisions of the biology curriculum		% proportion of questions set per content of the major divisions
Botany	30.76	26.51= 86.18%
Zoology	23.07	18.45 = 79.97%
General Biology	46.15	34.19 = 74.08%
Cummulative **%**	99.98	Mean (X)% = 80.07%

From table 1, the proportions of major divisions of the curriculum are botany courses represent 30.76%; zoology 23.1% and general biology courses 46.12%. The percentage weights of questions set on each of the divisions; botany, zoology and general biology are 86.18%, 79.97% and 74.08% respectively. The mean percentage of the entire curriculum courses examined during the examinations was 80.07%. Thus, the content validity of the examination 80% was very good.

Table 2. Percentage weights of cognitive categories examined in the undergraduate biology examinations (2012/2013)

Cognitive categories	Number of questions	% of questions per cognitive level	Deviation from standard (45:65)
Knowledge Recall Comprehension	91 120	28.62 37.73 **66.35**	**+21.35**
Application	03	0.94 = 1.0	
Analysis	49	15.41}	
Synthesis	47	14.77} = 32.69	
Evaluation	08	2.51} **(33.64)**	**- 21.34**
Total	**318**	99.98	

Table 2 shows the percentage of cognitive level tested in the examinations; knowledge and comprehension (lower order) 66.35% with +21.35 deviation, higher order cognitive questions; application approximately 1% and Analysis, Synthesis and Evaluation (32.64%) total 33.64% with -21.34 deviation.

Table 3. Percentage weights of cognitive categories examined in the undergraduate biology examinations (2013/2014)

Cognitive categories	Number of questions	% of questions per cognitive level	Deviation from the ideal (45:55)
Knowledge Recall Comprehension	84 85	40.19 40.66 **80.85%**	**+35.85**
Application	05	**2.39**	
Analysis	26	12.44 = 16.74	
Synthesis	09	4.30	
Evaluation	00	0 **19.13%**	**-35.87**
Total	**209**		

Table 3 shows the percentage of cognitive level tested in the examinations; knowledge and comprehension (lower order) 80.85% with +35.35 deviation, higher order cognitive questions;

application approximately 2.39% and Analysis, Synthesis and Evaluation (16.74%) total 19.13% with -35.87 deviation.

Table 4. Percentage weights of cognitive categories examined in the undergraduate biology examinations (2014/2015)

Cognitive categories	Number of questions	% of questions per cognitive level	Deviation from the idea (45:55)l
Knowledge Recall Comprehension	54 78	32.5 46.98 **79.48%**	 **+34.48**
Application	03	**1.8**	
Analysis	29	17.45}= 18.66	
Synthesis	02	1.21}	
Evaluation	00	0 } **20.46%**	**-34.54**
Total	**166**		

Table 4 shows the percentage of cognitive level tested in the examinations; knowledge and comprehension (lower order) 79.48% with +34.48 deviation, higher order cognitive questions; application approximately 1.8% and Analysis, Synthesis and Evaluation (18.66%) total 20.46% with-34.54 deviation.

Table 5. Percentage weights of cognitive categories examined in the undergraduate biology examinations (2015/2016)

Cognitive categories	Number of questions	% of questions per cognitive level	Deviation from the ideal (45:55)
Knowledge Recall Comprehension	149 93	50.85 31,74 **82.59%**	 **+37.59**
Application	02	**0.68**	
Analysis	43	14.67}= 16.71	
Synthesis	06	2.04}	
Evaluation	0	0} **17.39%**	**-37.61**
Total	**293**	99.98	

Table 5 shows the percentage of cognitive level tested in the examinations; knowledge and comprehension (lower order) 82.59% with +37.59 deviation, higher order cognitive questions; application approximately 0.68% and Analysis, Synthesis and Evaluation (16.71%) total 17.39% with -37.61 deviation.

Table 6. Percentage weights of cognitive categories examined in the undergraduate biology examinations (2017/2018)

Cognitive categories	Number of questions	% of questions per cognitive level	Deviation from the ideal (45:55)
Knowledge Recall Comprehension	71 87	33.49 **74.52** 41.03	**+29.52**
Application	09	**4.24**	
Analysis	22	10.37}	
Synthesis	19	8.96} = 21.22	
Evaluation	04	1.88} **(25.45)**	**- 29.55**
Total	**212**	99.97	

Table 6 shows the percentage of cognitive level tested in the examinations; knowledge and comprehension (lower order) 74.52% with +29.52 deviation, higher order cognitive questions;

application approximately 4.24% and Analysis, Synthesis and Evaluation (21.22%) total 25.45% with -29.55 deviation.

Table7. 5-Year Mean percentage weights of cognitive categories examined in the undergraduate biology examinations (2012/2013—2017/2018)

Cognitive categories	Number of questions	% of questions per cognitive level	Deviation from standard (45:55)
Knowledge Recall Comprehension	449 463	37.47 38.64 **76.11%**	**+31.11**
Application	22	**1.83**	
Analysis	69	14.10}=22.02	
Synthesis	83	6.92}	
Evaluation	12	1.0 } **23.85%**	**-31.15**
Total	1198	99.96	

Table 7 shows the mean percentage of cognitive level tested in the examinations; knowledge and comprehension (lower order) 76.11% with +31.11 deviation, higher order cognitive questions; application approximately 1.83% and Analysis, Synthesis and Evaluation (22.02%) total 23.85% with -31.15 deviation.

Discussion

This study revealed that questions were set on all the major divisions of the biology curriculum for the years reviewed. The mean score for content validity was 80.07% (table 1). This means that the examination questions were drawn from about 80% of the content of the curriculum in the years under review with about 20% of the content presumed unexamined. The examinations could be described as having a high content validity and a good indication of quality assurance for course contents coverage. The 20% of the content that seemed not assessed in the examinations could or might have been assessed in class test, quiz, assignment, project, and seminar which could account as continuous assessment. Since this is only a speculated, the finding of this study suggests the need to further improve on the content validity of the examinations by ensuring that more of the content areas are covered than hitherto during the subsequent semester examinations. Since the essay type questions were predominantly used for the examinations, the inclusion of more objective types and short structured items would enable more of the course contents to be covered and thus increasing the content validity of the examination papers. Such would guarantee better attainment of set academic standard and learning outcomes. On the premise of the high content validity, it could be adjudged that the examinees have adequately learnt the broad knowledge areas or content prescribed by the NUC, BMAS biology curriculum.

The second finding of this study revealed that the examination questions were distributed on all the cognitive levels but not in terms of expected proportion to meet the university standards. Table 7 showed that the lower order questions account for about 76.11% with +36.11 deviation, higher order cognitive questions; application approximately 1.83% and Analysis, Synthesis and Evaluation (22.02%) total 23.85% high level cognitive questions with -36.15 deviation. This proportion of the questions did not meet the ideal that questions set for such a university examination should tend towards 45:55 (IBBUL 2017).

This finding is similar to findings of related studies (Hamman-Tukur, 2000; Mustapha 2000, 2005& Mustapha, 2013; Swart, 2010; Hamafyelto, Hamman & Hamafyelto, 2015; Amua-

Seyi, 2016) that revealed high proportion of lower order questions. It could be deduced from the finding of the present study and the previously related studies; Mustapha, 2000, 2005 & 2013) that assessment in biology is mostly directed at content-oriented thinking and testing of factual knowledge with less demand on students to apply knowledge learnt to problem solving, and to develop broad range of high thinking abilities which most biology curricula emphasize. Testing students often on low cognitive questions will primarily lead students to adopt learning style that promote shallow or surface learning and efforts to memorise and recall facts (Malmfors, 2006; Swart, 2010). In this case, although the examinations revealed high content validity, the examination could be described as having low cognitive validity and may not guarantee the attainment of high cognitive abilities that are expected learning outcomes of studying biology at university level of education which requires them to be capable of applying knowledge and skills to solving theoretical and practical problem and to developing analytical and creative thinking abilities.

Implications of the Study

The findings of this study raise the several implications for students learning and quality assurance which examination questions should help to fulfil. To fulfil the objectives and the demands of the undergraduate biology curriculum, examination questions should be used as a stimulus for students to learn and explore the contents of the subject by engaging in deep study of the biology content and to seek knowledge beyond factual knowledge, to explore the possibility for applying knowledge and skills in novel situation theoretically and practically, These cannot be guaranteed by the qualities of the examinations questions which this study revealed to be predominantly lower order. The demands for effective students learning can therefore, best be fulfilled if high intellectual skills and abilities are the high focus of examination questions. It is important that for high intellectual development of biology students, examination questions as well as questions for assignments, group-discussion, case studies, classwork and problem based learning are questions that elicit high intellectual processing of information, reflective thinking, knowledge application and knowledge building and evaluation.

Assessment being a tool for quality assurance, in the context of this study, some important content and cognitive objectives of the biology curriculum might have not been tested. It can therefore be deduced that the assessment could not guarantee the full attainment of the learning outcomes of the minimum academic standard in terms of intellectual skills and abilities that students are to acquire. By implication the students who have taken the biology examinations have not been sufficiently challenged to think as problem solvers and may be incapable of applying what they have learnt to other context and engaging in high intellectual activities that demand critical, reflective, analytical thinking, and abilities to synthesis new knowledge and evaluate new body of knowledge which are part of the outcomes of undergraduate biology learning. This calls for quality assurance mechanisms and examination processes that can lead to improvement in the quality and standards of the biology examinations. In essence, improving the quality of the examination questions will promote effective learning approach and influence students study habits which will in turn lead to quality of students learning. The net effect is attainment of quality learning outcomes would be guaranteed.

Recommendations

In the context of the findings of this study, the following recommendations are given;

The content validity of the examinations and the questions used should be improved upon to ensure a more excellent coverage of course content being examined in future.

The examination questions for biology should include the use of more objective question especially the multiple type and short structured questions to the use of mostly essay questions to guarantee greater content validity.

Course lecturers/examiners would need to improve on the qualities of the examination questions they set to reflect more of high-order and problem solving questions than hitherto.

Course lecturers should promote broad range of high level thinking and problem solving abilities through their teaching and by exposing their students during class lesson, assignments, and projects to tasks that will promote such thinking.

To achieve the desired improvement, course lecturers and examiners should consciously balance the distribution of their examination/lesson questions proportionally among the Bloom's cognitive levels in the proportions across academic levels based on the university policy on examination standard as earlier referenced;

To ensure quality learning and quality learning outcomes, lectures teaching biology at the university level would need to improve on their assessment competences specifically on testing higher cognitive abilities and skills through self- development, peer review, and attendance of workshop on assessment.

Quality Assurance Directorate of the university should include in their quality assurance trainings assessment workshop for lecturers to sharpen their skills in setting high-order questions.

The NUC should ensure that at the next biology curriculum review higher cognitive objectives are more explicitly described and place greater emphasis on assessment of high cognitive demand of the biology curriculum.

It is equally important that external examiners be acquainted with the curricular demands for development of higher cognitive skills and abilities in learning biology and to ensure that during moderation, course lecturers set high quality and standard examination questions in assessment of biology.

Conclusion

The questions used for the assessment of undergraduate biology significantly covered the contents of the courses examined. Thus, the examinations have a high content validity and therefore the examinations to a considerable extent served a good measure for quality assurance of the content coverage. This guarantees that the students have learnt a high proportion of the contents of the different course contents necessary for then to acquire the broad-balance knowledge of biology. However, the unexamined portions of the curriculum are equally important for the overall attainment of quality biology education. Secondly, the examinations analytically assessed different cognitive abilities, but the examination on the whole tested more of lower order thinking abilities than testing of higher order thinking skills. The findings of the study have implication for quality assurance and the need to improve practice. In other words, the students had mostly engaged in surface learning and attained mostly low cognitive skills than the expected higher intellectual skills and abilities as outcomes of learning biology at the university level

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