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Assessment of higher order thinking skills: A case of Uganda Primary Leaving Examinations

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ABSTRACT

The study set out to give a conceptual definition and assessment of Higher Order Thinking skills (HOTs), and establish the proportion of HOTs and Lower Order Thinking skills (LOTs) questions within the 2010-2016 Uganda Primary Leaving Examination (PLE) questions. The study used secondary literature to define HOTs and provide an assessment framework for HOTs. The assessment framework was then used to categorise all PLE questions for the years 2010 to 2016. All the examinable subjects within the PLE, English Language, Social Studies (SST), Science and Mathematics were categorised according to the HOT and LOT categories. The study reveals an overall mean value of 86.8% of LOT questions and a mean value of 13.2% of HOT questions. The study recommends the use of the Revised Bloom's Taxonomy framework in the categorisation of assessment items and that more HOT questions are included in the PLE.

Keywords: Higher order thinking, creativity, educational assessment, human development, development, Uganda Primary Leaving Examinations.

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INTRODUCTION

In most of the societies around the world, education is considered a great asset for economic development (Ozturk, 2001). It contributes towards socio-economic and political modernisation as well as the well-being of individuals within a society (Ogawa and Nishimura, 2015). This normally happens by increasing a "person's and a nation's productivity (Ozturk, 2001:39). Education can largely contribute to economic development when learners develop the knowledge, skills and values required and appropriate for the labour market (Ozturk, 2001; UNESCO, 2000). To tune education towards an economic development perspective, Altinyelken (2015) argues that the current global shift from inputs and outputs to outcomes and from processes to results is a great minds-shift in education and development. His argument is in favour of the current global paradigm shift from measuring a nation's quality of education based on attendance and completion rates towards the intended learning outcomes more particularly higher-order thinking skills.

In Africa, although statistics indicate that the continent has achieved a steady progress in the education sector, it is still a matter of debate. Most African countries have achieved Universal Primary Education enrolment rates above 90 per cent (Altinyelken, 2015; Ogawa and Nishimura, 2015). On a theoretical note, such a progress ties in with the Sustainable Development Goals (SDGs) on education and global focus on human capital development for national sustainable development. The reality on the ground, however, seems to suggest that there are salient challenges concerning the quality of assessment of learning outcomes and systemic reforms which might impend the process of human capital development (Allen et al., 2016). This situation is

becoming even more pronounced as studies continuously reveal that the school enrolments alone are not sufficient for national development or individual's wellbeing (UNESCO, 2000; Wagner, 2011).

At the national level, Uwezo (2015) reports that there are also many Ugandan children and youth who are in school but either not learning or not learning what is relevant for their future life achievements. Odongo (2018) has equally argued that many of the students, in Uganda, who are "successful in school" have not acquired enough of the skills they need for their current and future including the world of work. In terms of assessment and examinations, Allen et al. (2016) have argued that most of the knowledge and skills learners need today and for their future have little or no role in the formal learning, tests and examinations. This is supported by Altinyelken (2015) who argues that most examinations in Uganda, including PLE, hardly call for critical consciousness but rather focus on "the evocation of responses that involve repetition rather than critical analysis and reflection, lack of procedures designed to improve students' higher-order cognitive skills" (p.6).

The debate about the inadequacy of assessments and examinations in Uganda to measure higher order thinking skills is not new. Chapman and Snyder (2000) and Snyder (1997) had previously argued that these assessments and examinations in Uganda focus on superficial or rote learning instead of deep learning which would enhance higher order thinking skills. The inadequacy of assessments, in Uganda, to measure higher order thinking skills have prompted Allen et al. (2016) to argue that Uganda's current assessment system does not produce the requisite results to build a labour force fit to meet existing and future economic, social and political demands. Starting from Allen and his colleagues' argument, this article argues that an assessment which merely measures superficial learning can hardly enable Uganda to achieve its National Vision 2040 or Sustainable Development Goals (SDGs). However, whereas the above studies have eloquently revealed the shortfalls of Uganda's assessment in measuring higher order thinking skills, there is little consensus on the definition of the term and what constitutes Higher-Order Thinking skills (HOTs). This article, therefore, seeks to give a conceptual defination of higher order thinking skills and establish the proportion of examination questions within Uganda Primary Leaving Examinations (PLE) which can be termed as HOTs questions.

Problem statement

An analysis of the teaching and learning practices in Uganda reveals an almost exclusive reliance on lecture-style techniques generating rote learning. There is little work done to help students develop Higher Order Thinking skills (HOTs) such as; critical, reflective and creative thinking and problem-solving. Abonyi (2014) argues that teachers often model their classroom practices according to the nature of national examinations. National examinations particularly Primary Leaving Examinations (PLE) have been blamed for influencing the teachers' classroom practice in Uganda – negative washback effects (Chapman and Snyder, 2000). However, there isn't enough evidence, if any, to ascertain the levels of thinking which are called for in the Primary Leaving Examinations (PLE). This article, therefore, seeks to provide an evidence base to highlight the levels of thinking called for in the Primary Leaving Examinations.

Purpose of the study

This study was intended to provide a conceptual definition of Higher-Order Thinking, its assessment and establish the proportion of examination questions within Uganda Primary Leaving Examinations (PLE) which can be termed as HOTs questions (2010-2016).

Specific objectives

The study set out to:

i. Give a conceptual definition of higher order thinking skills;
ii. Provide an assessment framework for higher order thinking skills; and
iii. Establish the proportion of HOTs and LOTs questions within the 2010-2016 PLE questions.

METHODOLOGY

The study used a case study design. Quantitative study techniques were employed. The Primary Leaving Examination (PLE) questions for seven consecutive years (2010-2016) formed the unit of analysis.

The study considered all the four PLE examined subjects: English, Mathematics, Science and Social Studies (SST). Seven consecutive years (2010-2016) were considered for the study. In all 2,084 questions were put into the sample frame for eventual interpretation and analysis.

All the questions were analysed based on the Revised Bloom's Taxonomy (RBT) as indicated in Figure 1. In categorising questions according to the RBT, the study used the command verb or phrase which often directs the candidate what to do. For example, "Give the past tense of the underlined word". This question requires a

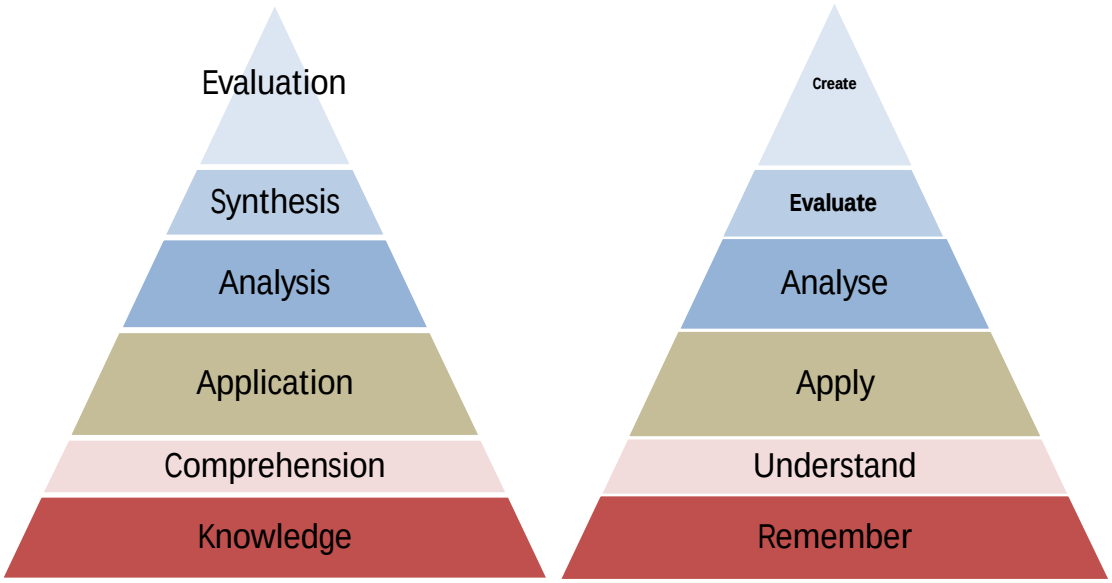

Figure 1. Bloom's original taxonomy and the revised taxonomy by Anderson et al. (2001).

candidate to recall the past tense of a given word and this fall under level 1 (Recall).

Using the RBT and the associated process action verbs, all questions were categorised according to the complexity levels in their respective years. During the categorisation, care was taken to observe cases of repeated questions in the consecutive years. In terms of complexity, the more a question is repeated the more it reduces to the level of mere memorisation as it reduces its novelty.

The study also recognised the common misuse of the command words (action process verbs) which often alters the level of complexity. For example, some questions carry a command verb "explain" when in the real sense it requires the candidates to "give".

For analysis, all questions were checked for their levels of cognition and simple percentages were computed per subject per year from 2010 to 2016. Mean values were computed to understand the levels of complexity for each subject over time and to have a meaningful comparison of the levels of complexity among the subjects: English, Social studies, Science and Mathematics.

CONCEPTUAL UNDERSTANDING OF HIGHER ORDER THINKING: DEFINITION AND ASSESSMENT

In this section we give a conceptual definition of Higher Order Thinking (HOT) as given in the available literature. Next, we give an assessment framework that can be used by teachers and test developers to write down items for assessment or set lesson objectives according to the order of hierarchy and complexity.

Defining higher order thinking

The area of Higher Order Thinking skills (HOTs) has been widely investigated since the time of the great philosophers Socrates, Plato and Aristotle (Lewis and Smith, 1993). Socrates was fond of challenging his contemporaries to go beyond the "loose" thinking by asking high order thinking questions and since then philosophers have contended that critical thought is pivotal for the moral good (Lewis and Smith, 1993). Philosophy has thus traditionally looked at higher order thinking skills in terms of reasoning. Following this background, Aristotle defines a human person as a reasoning animal - *homo est animale rationale* (Ozmon and Craver, 1981; Mara, 2007). Reasoning has been used by Maier (1937) as cited in Smith and Szymanski (2013) to mean any *productive* (higher-order thinking) behaviour in which an individual is able to exercise his/her evaluative, imaginative and creative skills. Elsewhere, productive behaviour (reasoning) is associated with critical, logical, reflective, metacognitive and creative thinking (Mainali, 2012). On the other hand, *reproductive* (low order thinking) behaviour is associated with lower order thinking skills in which an individual just recalls and reproduces what he/she previously (superficially) learnt.

Newman (1990) defined higher-order thinking skills by making a distinction between higher order thinking skills from lower order thinking skills. He noted that higher-order thinking skills are skills that challenge learners to "interpret, analyse and manipulate information" (p.44). Resnick (1987) defined higher order thinking in terms of making inferences. Both Newman (1990) and Resnick (1987) agree that higher-order thinking skills

imply one's ability to elaborate a given material, make meaning beyond what is explicitly presented, build adequate representations, analyse and construct relationships. For example, in order for students to show masterly of higher order thinking skills, they need to make an inference and make meaning of the information beyond what is written in the text or said in an oral conversation. The repetition of what is said or written constitutes lower order thinking skills.

Newman (1990) and Abosalem (2016) argue that the phrase higher-order thinking skills is relative to lower-order thinking skills, as a specific question, situation or content might require a student to apply higher thinking skills whereas another one requires lower thinking skills. This resonates well with philosophical thinkers such as Giussani (1996) and Resnick (1987) who underscore the centrality of experience in the thinking process. For example, a student in a rural setting who has never visited a supermarket may find it extremely hard to answer questions related to the use of a supermarket but after being exposed to what a supermarket is and how it operates; it becomes easier to reason out questions related to the use of the supermarket. This implies that factual knowledge is a prerequisite for higher order thinking skills. In this article, we argue that there cannot be higher-order thinking skills without lower order thinking skills.

Thus, drawing from what is said so far, this study takes higher-order thinking skills to mean an individual's ability to interrelate, rearrange, extend and or use the available information to achieve a given purpose or find solutions to nonroutine problems. Higher-order thinking skills include analytical, critical, logical, evaluative, reflective, metacognitive and creative skills. In terms of assessment, we can understand well higher-order thinking skills through a taxonomy of thinking in which the assessment questions can be classified according to their levels of complexity. This is given in the next section.

Assessment framework of higher-order thinking skills

Recent decades have witnessed considerable attention on educational assessment. This has been mostly in the area of the definition, types/forms, processes and functions or purposes and the content (Allen et al., 2016; Kellaghan and Greaney, 2004; Mitana et al., 2018). In terms of definition, assessment is often defined as the process of collecting information about the learning process and learning outputs in order to make an appropriate judgment about learners and the learning process (Kellaghan and Greaney, 1992; Wagner, 2011). In this article, we define assessment as the process of collecting relevant information about learners, the learning process, the content, and the learning outcomes for purposes of making a judgment on the learning process, the learners, the curriculum and the educational objectives.

In the 1950s, Bloom and his colleagues (Bloom et al., 1956) established a hierarchy of educational objectives, which has since then been generally referred to as Bloom's Taxonomy. Although Bloom and his colleagues did not explicitly write about the order or complexity of thinking, their educational objectives involved a cognitive process ranging from lower order thinking skills (knowledge) to high order thinking skills (evaluation). After a number of years, his student Anderson and his colleagues revised the Bloom's Taxonomy in which they changed from the use of nouns to verbs and also pointed out that the highest level of thinking is not evaluation but "to create" (Anderson et al., 2001).

In the revised edition of Bloom's Taxonomy (Figure 1), although the taxonomy retained the hierarchical arrangement of educational objectives from simple to complex and from concrete to abstract, more attention was placed on the cognitive processes beyond the subject matter (Anderson et al., 2001). This facilitates the assessment of the masterly of the subject content as well as the level of thinking involved. An assessment item typically consists of two distinctive parts. The first part consists of a noun or noun-phrase which describes the subject content. The second part consists of a verb or verb-phrase which describes the cognitive process or the level of thinking involved. For example, "Name anyone Relief Agency that cares for the people who have been affected by landslides in Uganda" (Uganda National Examinations Board (UNEB), 2017 p. 271). "Name" is a verb that belongs to the cognitive process "Remember". This question has two things to remember: one Relief Agency and the fact that it cares for the people who have been affected by landslides in Uganda. This question belongs to the lowest level of Bloom's taxonomy.

In the revised Bloom's taxonomy, as more emphasis was placed on the cognitive process, 19 cognitive processes were identified and each of them shows the level of cognitive complexity involved in an educational objective or an assessment item. Figure 2 indicates 19 cognitive processes as shown by the RBT.

Figure 2 shows the categorisation of the thinking processes. Figure 2 indicates three levels of recall, understand and reason. Remember is the lowest level of cognition in which a learner is expected to recognise or recall information. Understand is the second level of cognition and the learner is expected to interpret, exemplify, classify, summarise, infer, compare or explain. Next to this level is "apply" in which a learner is expected to execute, use or implement something using the learnt information; for example, using a formula to calculate a

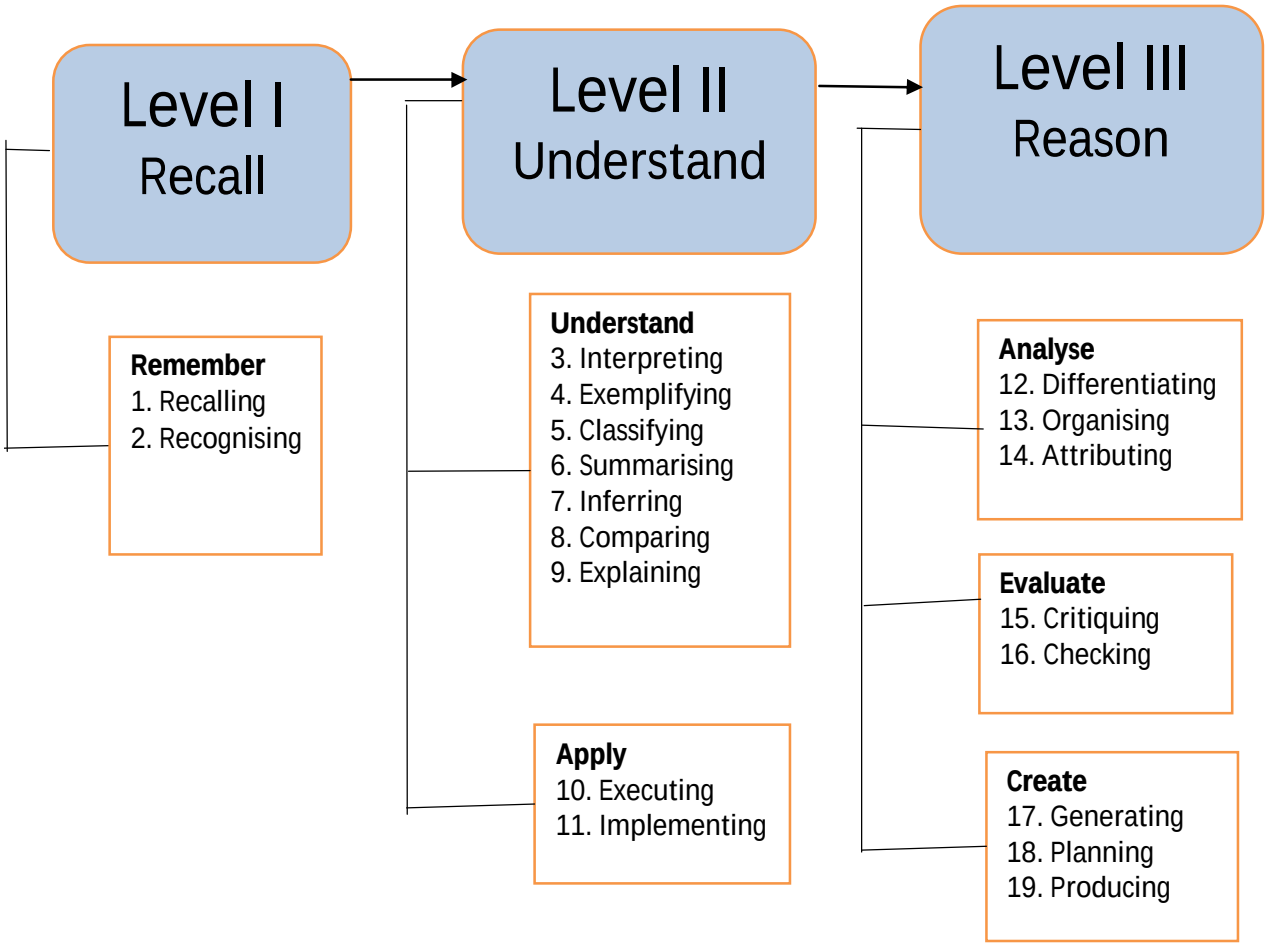

Figure 2. Revised Bloom's Taxonomy of Educational Objectives: Adapted from Anderson et al. (2001).

mathematical problem. In this case, all questions belonging to these three levels fall under the category of lower thinking skills questions.

On the other hand, the last three levels of the revised Bloom's taxonomy: analyse, evaluate and create belong to the category of higher order thinking skills. Under analyse, a learner is expected to differentiate, organise and attribute. Under evaluate, a learner is expected to critique or cheque something. Under create, a learner is expected to generate, plan or produce a piece of work which could be an item, idea or text.

In most cases, categorisation of the assessment items is based on the verb or the verb-phrase used as indicated by the 19 cognitive processes. For example, the question: "Mention any one problem people living in mountain areas face", is a recall question. It merely instructs the learner to recall what he/she studied about the problems faced by people living in mountain areas. On the other hand, the question, "Ssendawula was facing the North. He turned clockwise through 90°. What was his new direction?" This is a level II question as it requires the learner to apply the knowledge of angles as well as interpreting the directions of a compass.

The analysis of the Revised Bloom's Taxonomy (RBT) reveals that both the original Blooms' taxonomy and the revised one consider a hierarchical order of complexity of cognitive processes. However, in this paper, we argue that it is difficult to keep a strict hierarchical order of cognitive processes. Instead, using a matrix of the knowledge dimension as given in the Revised Bloom's Taxonomy and the six cognitive processes, we present an assessment framework that enables a teacher to set the lesson objectives or the test items within a matrix of complexity (Figure 3).

The horizontal arrow shows the increasing complexity of the cognitive processes starting from the first level, "Remember" through "Create". It explains the "how" part of a lesson objective or test item. This is usually indicated by the verb or verb phrase of the test item or lesson objective. The vertical arrow, on the other hand shows

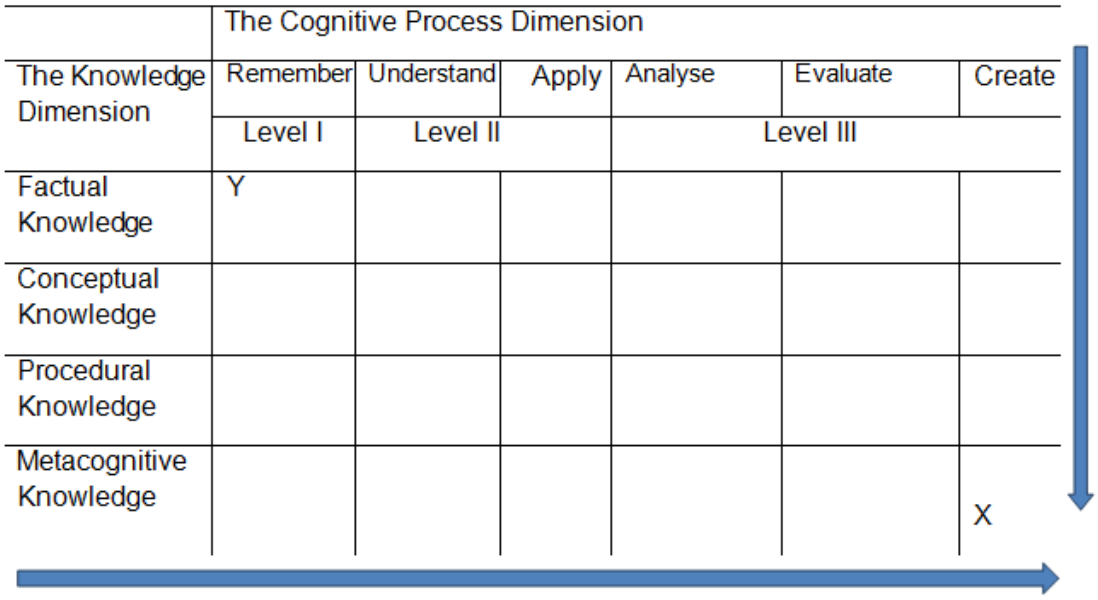

Figure 3. Taxonomy matrix.

the knowledge dimension of a lesson objective or test item. It explains the "what". This is usually indicated by the noun or the noun phrase of the lesson objective or test item. Using the above matrix, the highest level of HOT is shown in the box marked X. The box marked X shows one's ability to create at a level of metacognition. The box marked Y on the other hand shows the lowest level of thinking. It indicates one's ability to recall factual knowledge. Between box Y and box X, one can allocate multiple levels of thinking within one or more levels of cognitive process dimension. The further one moves towards the bottom right hand side of the matrix, the higher the level of cognitive skills called for in a lesson objective or test item. This study conceptualises higher order thinking skills as level III of the taxonomy matrix. It thus consists of the ability to analyse, evaluate and create.

RESULTS AND DISCUSSION

The study findings are presented according to the corresponding study subjects at the primary seven in Uganda. The study subjects are English, Social Studies (SST), Mathematics and Science. Each of the study subjects is presented in terms of the overall percentages of the levels assigned. Figures, 4, 5 and 6 represent the analysis of the questions.

The study reveals low but stable levels of the proportion of recall questions over time (Figure 4). The recall (Level I) questions have a mean value of 19%, understanding (Level II) questions have a mean value of 65% and the reasoning (Level III) questions have a mean value of 16%. In terms of higher-order thinking skills and lower order thinking skills, the study reveals the mean values of 18 and 84%, respectively. This means that although the majority of questions belong the level II of the assessment framework, there is still exists the need to increase the number of questions in the reasoning category which comprises analysis, evaluation and creativity skills.

The study reveals a high proportion of the Social Studies questions in the recall category (Figure 5). The proportion of recall questions has been rising over time from 53.1% in 2010 to 83.8% in 2016 while the proportion of understanding questions has been decreasing overtime from 34.2% in 2010 to 13.5%. Overall, the proportion of questions in the recall (level III) category is high with a mean value of 62%, the proportion of questions in the understanding (level II) category has a mean value 26% and the mean value of the reasoning (level III) category is 12%. In terms of higher order thinking and lower order thinking skills, the study reveals a very high proportion of lower order thinking skills questions compared to higher order thinking questions with the mean values of 12% and 88% respectively. This implies that the assessment of social studies mainly tests superficial learning instead of deep learning. Yet, deep learning would have been more important for learners present and future life including the world of work.

Figure 6 shows that the proportions of the Mathematics questions in all the levels are relatively stable with more questions belonging to the understanding (Level II) category. The year 2015 did not

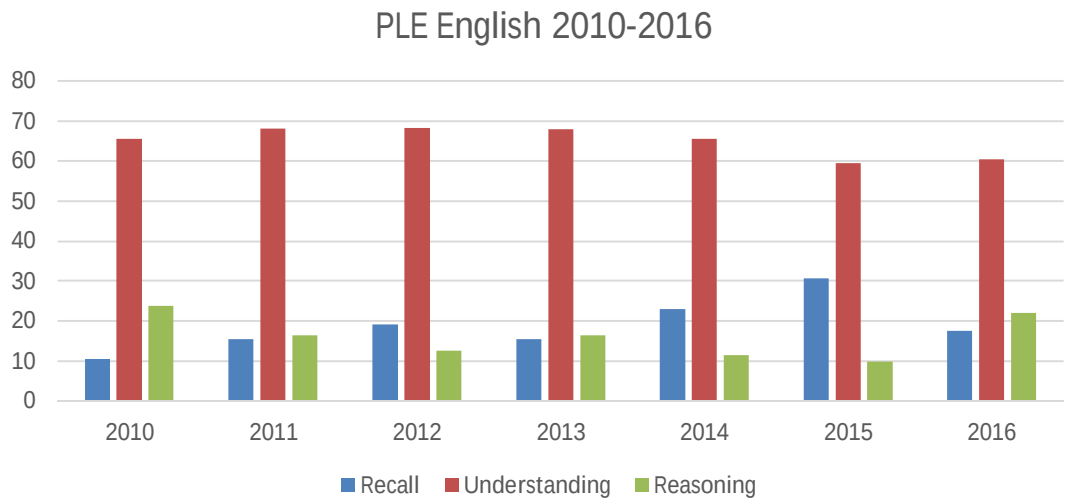

Figure 4. Analysis of English questions.

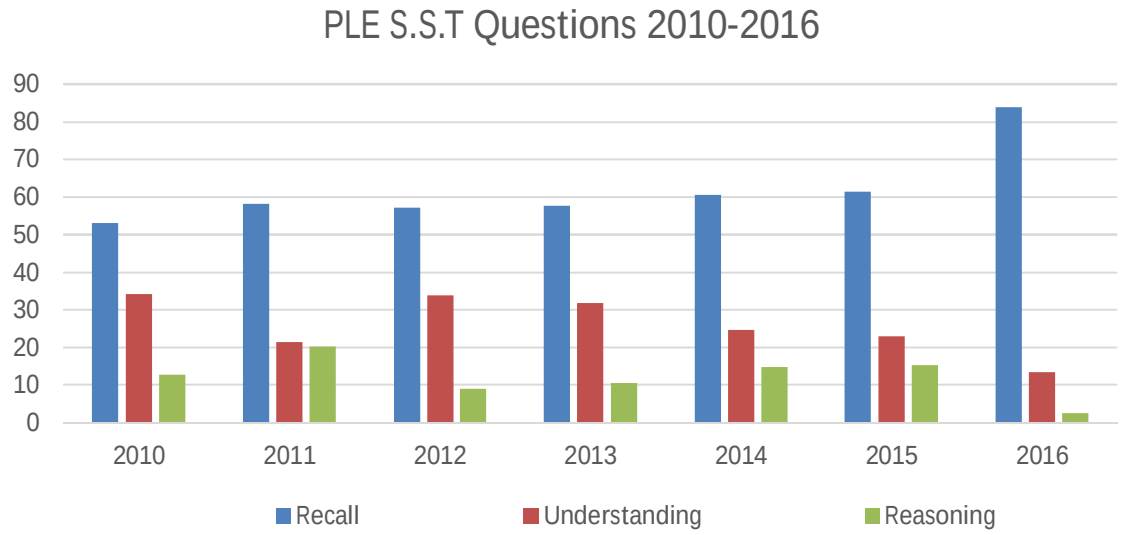

Figure 5. Analysis of S.S.T questions.

have any question from the recall category. Overall, the study reveals high proportions of questions in the categories of understanding and reasoning. The recall (level I) category has a mean value of 11%; the understanding (level II) category has a mean value of 69%; and the reasoning (level III) category has a mean value of 20%. Just like the English language, the Mathematics assessments present a better picture of many questions with the category of understanding (with a mean value of 69%). However, the subject also faces the same challenge that most of the questions do not measure up for higher order thinking skills. Only a mean value of 20% represents questions measuring up for higher order thinking skills while the rest fall under the category of lower order thinking skills with a mean value of 80%. This presents a serious challenge to development as mathematics is often considered the mother of all sciences without which there are deem hopes for science and technological developments for Uganda.

Figure 7 shows an increasing trend in the proportion to the Science questions in the recall category and a decreasing proportion of questions in other categories. Overall, the figure reveals the proportion of recall (level I) questions category with a mean value of 63%; the understanding (level II) questions category with a mean value of 32%; and the reasoning (level III) questions category with a mean value of 5%. In terms of higher

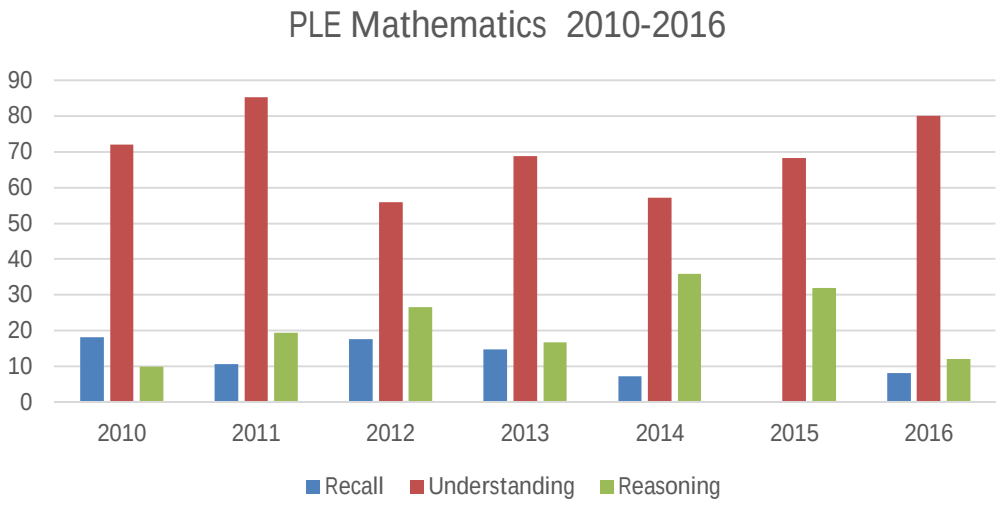

Figure 6. Analysis of Mathematics questions.

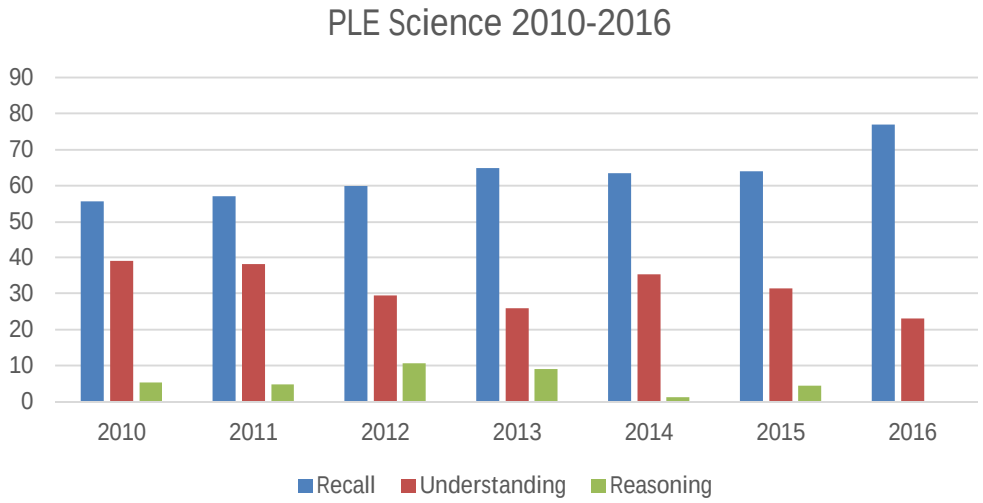

Figure 7. Analysis of Science questions.

order thinking skills and lower order thinking skills, the science assessment was found with the highest proportion of question calling for lower order thinking skills with a mean value of 95%. Higher order thinking skills questions were found to comprise only 5%. This might have serious negative implications for the development of Uganda as it aims at becoming a middle-income country with a high base on science, technology and industrialisation.

In terms of categorisation per subject, the study reveals that Science and Social Studies (SST) have higher proportions of questions belonging to the recall (level I) category with mean values of 63% and 62% respectively. On the other hand, the study reveals low proportions of the questions in the recall (level I) category for English and Mathematics with the mean values of 19 and 11%, respectively.

Figure 8 shows that English and Mathematics subjects have high proportions of the understanding (level II) questions with the mean values of 65 and 69%, respectively. On the other hand, there are low proportions of understanding (level II) questions within the SST and Science subjects with 26 and 32% mean values respectively. However, none of the subjects was found with a proportion of reasoning (level III) with a mean value higher than 20%. The mean values of the proportion of reasoning (level III) questions are 12, 16, 5 and 20% for SST, English, Science and Mathematics, respectively. Overall, while LOT skills questions (Level I and Level II) were categorised with a mean value of

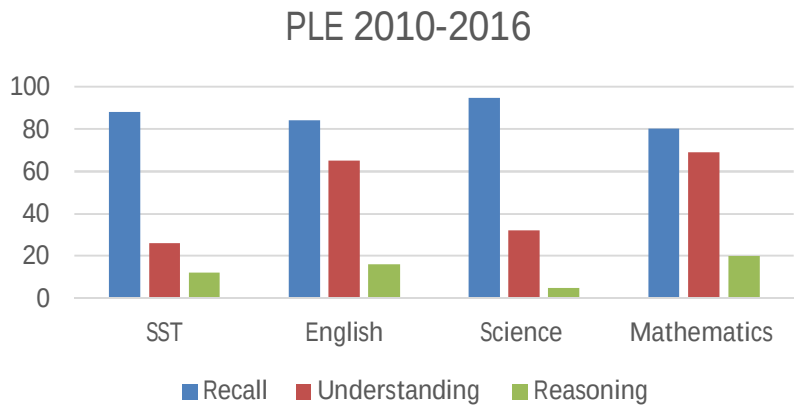

Figure 8. Categorisation per subject.

86.8% HOT skills questions (Level III) were categorised at the mean value of 13.2%.

CONCLUSIONS AND RECOMMENDATIONS

Different authors give definitions of Higher Order Thinking (HOT) skills agreeing that HOT involves an individual's ability to interrelate, rearrange, extend and or use the available information to achieve a given purpose or find solutions to nonroutine problems. This is essential for education and development because school graduates require such skills as creativity, imagination and innovation in order to overcome any emerging production and development challenges in their lives including the world of work. Based on this, the study recommends schools to refocus on nurturing learners' HOT. This will increase learner's readiness for life after school including the world of work.

The Revised Bloom's Taxonomy (RBT) is handy when teachers or assessment bodies wish to categorise the levels of complexity of their test items. The categorisation allows a hierarchical structure in which teachers or assessment bodies can easily locate the thinking competencies of the learners at a particular time. This is important as it enables the teacher or assessment body to focus on the level of thinking expected at a given learning level. This study recommends the use of the Revised Bloom's Taxonomy is setting assessment items.

The proportion of questions belonging to Low Order Thinking (Levels I and II) is higher than the proportion of questions belonging to higher order thinking (Level III). This has development implications. Such assessment inadequately prepares learners for life beyond school including further studies and the world of work. This study recommends that more questions calling for higher-order thinking skills are included in the PLE. This will in the long run prompt teachers to teach learners higher order thinking skills as they prepare learners for end-of-cycle (PLE) examinations.

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