Basic Education curriculum effectiveness analysis in East Africa: Using the 'Surveys of Enacted Curriculum' framework to describe primary mathematics and English content in Uganda

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Abstract

The most important basic education policy question in the developing countries of Sub-Saharan Africa today relates to how to transform schooling into actual learning for the majority of children who are now enrolled in primary schools across the continent. Recent evidence from annual learning assessments conducted in the three East African countries of Kenya, Tanzania and Uganda reveal extremely low learning gains as children progress through primary school grades. Whereas a number of factors have been studied, there is shockingly very little evidence on basic education curricula effectiveness in East Africa. Twaweza East Africa, has adapted the Surveys of Enacted Curriculum framework to analyze the content embedded in the primary school curricula in East Africa. In this study, we develop subject taxonomies for Mathematics and English – the two main learning areas at lower primary school level in Uganda – and analyze the distribution of relative emphasis on content that is embedded in the thematic curriculum. We find that the lack of nationally-agreed well thought subject-specific comprehensive taxonomies is manifested in form of content coverage inconsistencies which hinder achievement of planned progressive learning across grades. We also find evidence of curricula over-ambitiousness manifested through the lack of emphasis, by the thematic curriculum standards, on development of the low-order thinking skills and on covering critical foundational language competence topics. This suggests that a policy that slows down the pace of learning in lower grades and emphasizes foundational skills development might improve learning profiles for the majority of Ugandan children who enroll in primary school without attending pre-primary education.

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1.0 Introduction

Whereas a significant number of primary school-aged children, especially in Sub-Saharan Africa (SSA), are still out-of-school[3], the majority are now enrolled and attend school more often (United Nations, 2015). For the majority of these enrolled children however, very little actual learning occurs as they progress through grades (Pritchett & Beatty, 2012). This leads to an important global education policy question – how can we ensure effective learning for every child that is enrolled in school? Although a number of studies addressing this question have been conducted in the recent past, there is very little evidence on the effectiveness of the curricula in East Africa[4] (Atuhurra, 2014; Twaweza, 2015a).

In this paper, we define curriculum as the prescribed content to be taught and learned, which provides the basis for assessment in form of tests (Twaweza, 2015b). It is clear from this definition, that the curriculum lies at the heart of the learning process and its' significance for children's learning achievements in early childhood is critical, mainly because ineffective learning in early childhood hinders development of critical foundational skills that a child needs to succeed both in school and in the world of work (UNESCO, 2014). Since 2007, Uganda has implemented a thematic curriculum for the first three lower primary grades, whose main goal is to achieve quick development of foundational literacy, numeracy and life skills. The content of this curriculum is organized around themes of immediate meaning and relevance to the learner and is delivered in the child's local or familiar language (Altinyelken, 2010). In grade four, the primary school curriculum transitions from being theme-based to subject-based and from using the child's familiar language to English as the medium of instruction[5]. Although the primary school curriculum advocates for a formative assessment approach that focuses on a learner-centered diagnosis and taking of remedial steps for effective learning during the normal course of teaching, the practical realities of large class sizes have meant that this is hardly done (Ezati, 2016). In practice, there is clearly overemphasis on high stakes summative assessments, typified by the end of primary school national examinations – the Primary Leaving Examinations (PLEs). A few recent studies of the thematic curriculum in Uganda have praised its' intentions, but also repeatedly highlighted its' lack of relevance to the contextual realities prevailing in schools and classrooms across the country, especially outside of the urban settings of major towns. In one of the early studies, Altinyelken (2010) sought to understand teacher perspectives of the thematic curriculum. The study found that the initial enthusiasm teachers had developed for the new curriculum quickly turned into frustration as they discovered that its' recommended pedagogical approaches were inappropriate and impractical in their settings. While analyzing the P3 and P6 children's performances in recent National Assessments of Progress in Education (NAPE), Najjumba & Marshall (2013) raise questions on some critical curriculum aspects including time allocation, content sequencing and pacing, thus suggesting a fundamental structural problem with the design versus delivery aspects of the thematic curriculum. A more recent review of the basic education curriculum reforms that

[3] About 57 million children of primary school going age are out-of-school worldwide, majority of whom live in Sub-Saharan Africa (United Nations, 2015).

[4] Areas that have been covered extensively in the recent past included teacher effort and performance, pupil peer effects, pedagogical practices, community involvement, class size effects, school choice, and pupil health statuses.

[5] The primary school curriculum identifies three clear cycles: lower primary covering grades one to three, the transition grade four, and upper primary covering grades five to seven.

have taken place in Uganda since 1962, finds that in essence, all the five major reforms did not achieve, in practical terms, any significant progress. Critical curriculum aspects such as scope of content covered, sequencing and alignment were never really addressed in any meaningful way (Ezati, 2016).

Early Childhood Development (ECD) relates to children's development of both cognitive and non-cognitive abilities in their early formative years, usually by age nine. A large body of cross-disciplinary studies have found evidence to the effect that even after adjusting for maternal education, ECD is still strongly associated with variations in children's basic learning skills, mainly relating to receptive vocabulary or language abilities and the development of executive functions of memory and attention. In most developing countries, household wealth remains a major determinant of both pre-school attendance and the child's observed development outcomes (World Bank, 2015). Between the ages of three and six years, children in Uganda are eligible to attend pre-primary school, a place where they experience the greater part of cognitive and other critical life skills' development. In pre-school, children are continuously guided and supported in discovering themselves and their environment through persistent stimulation and cultivation of such life-critical skills as control of own impulses, appreciation of other people's perspectives, focused attention, active listening, completion of assigned tasks and appropriate behavior. While conducting the annual household-based learning assessment for 2015, Twaweza found that only 27% of children in Uganda aged between three and five were attending pre-primary education, translating into a four percentage point improvement from 23% in 2011 (Uwezo, 2016) . This finding suggests, potentially that about 42% of children will be able to attend by 2030[6]. Large location and socioeconomic status-based disparities in attendance do exist however, with over a half (53%) of the 3-5 year-olds found to be attending in urban areas in 2011 while only 20% of the rural-based children were attending (Uganda Bureau of Statistics, 2012). With only 7% of children from the lowest wealth quintile attending, and considering that the majority of the ECD centers in Uganda are privately owned[7] and not fee-free, the most prominent constraint hindering universal enrolment in pre-primary schools has a lot to do with the associated costs of attendance (UBOS, 2012; Wodon, Tsimpo & Onagoruwa, 2016). In his bestselling thesis on understanding success, Gladwell (2011) highlights opportunities (or the lack thereof) that accrue from early life and persist for years, thereby locking children into overall life achievement or underachievement. In Uganda, the few children that attend pre-schooling obtain a unique head start advantage that, cumulatively results into enormous returns in form of better learning achievements and overall long-term life outcomes.

In place since 2005, Uganda's pre-school curriculum is a needs-based learning framework designed to develop critical foundational skills for three to six year olds. By the time they complete the final year of pre-school, children are expected to be able to apply mathematical concepts in their day-to-day experiences and use appropriate English language to communicate with others. Children at this stage have developed 'number sense' and 'basic mathematics operation' competences so as to be able to recognize or create number patterns and represent or interpret information in pictorial

[6] This is on the basis of an assumption of a common trend using two data points – 2011 and 2015.
[7] About 80% of ECD centers are privately owned (MoGLSD, 2013).

form. Relating to language ability, they have developed phonics and phonemic awareness competences so as to be able to listen to and re-tell simple stories, use acquired vocabulary while playing, read simple stories, and write own stories about personally meaningful experiences (NCDC, 2005).

While the Government White Paper (1992) specifies broad aims and objectives of education to be achieved at each basic education level in Uganda, we have not found any evidence that suggests, until now, the existence of a systematic and comprehensive multidimensional content taxonomy for basic education in Uganda that specifies, for each broad learning area, the relevant topics, subtopics and cognitive demand (performance expectations) levels to be achieved in order to reach these broad education goals. This not only makes international comparisons difficult, which compromises the global competitiveness of Uganda's basic education, but also makes it extremely hard to objectively assess the scope, sequence, relevance and alignment of the content embedded in the curriculum at each cycle and grade level and how it fits in subsequent levels. In relation to pre-primary attendance and the contextual relevance of the thematic curriculum in Uganda, it seems quite important to generate policy-relevant evidence that explains how in-class instruction and learning, especially in very overcrowded lower primary grades, is affected by children's pre-school attendance status. As a first step to establishing this evidence, it is critical to objectively describe, preferably quantitatively, the content that is embedded in the national curriculum standards and assessments, and then to establish their alignment with the actual teaching and learning that takes place in schools (Porter, 2002; Smithson, 2016).

In this study, we focused exclusively on describing the national curriculum content standards for lower primary grades 1-3 for two main learning areas, English language and mathematics. To achieve this, we composed three-member curriculum expert teams for each of these two core subjects, who were trained on the Surveys of Enacted Curriculum (SEC) methodology. Using the expert-generated topic and sub-topic level data sets arising from coding and rating of each learner competence as indicated in the content standards, we conducted detailed grade-specific descriptive analyses that portray relative emphasis areas of the thematic curriculum in Uganda. Furthermore, we report indicator measures that summarize detailed quantitative relationships representing comparisons of two-dimensional arrays of content descriptions that generate alignment characteristics for the two subjects. Subsequent studies will cover our analyzes of the grade four transition curriculum, the upper primary curriculum, the end-of-primary cycle national assessments, and the in-class teacher instructional practices and delivered content[8].

We find that three major topics form the main focus of the mathematics strand in lower primary, 'number sense', 'operations', and 'measurement'. Other topics that receive comparatively less emphasis at this level include 'sets', 'data displays', 'basic algebra' and ''geometry'. The overall structure of topics and performance expectations suggest a very high degree of similarity in prescribed content for the three grades, clearly demonstrated by the high alignment measures of the between-class topic coverage, cognitive complexity, balance of representation and overall alignment indices. In all the three grades, the standards place most emphasis on the development

[8] In September 2016, we conducted a pilot teacher survey of instructional practices and content involving six hundred primary school teachers from two districts – Wakiso and Iganga.

of computational proficiency and conceptual understanding of mathematical ideas. The lower-order performance expectations of reciting, memorizing and recalling mathematical facts receive very minimal emphasis in lower primary grades.

The English strand in lower primary covers a larger number of topics – seven – with some topics getting dropped while others are added along the way as the child progresses through the three grades. Only two topics however, are consistently covered in all the three classes, 'speaking and presenting', and 'elements of presentation'. Overall, three topics form the core emphasis of the English strand in the thematic curriculum standards – 'speaking and presenting', 'language study' and 'comprehension'. Akin to the performance expectation findings for mathematics, we find that the English strand emphasizes the development of children's relatively higher-order cognitive abilities of 'demonstrating conceptual understanding', and 'analyzing or conjecturing'. Again, little to no emphasis is put on the development of 'recall or memorize', and 'perform or explain' levels of cognitive demand in lower primary grades.

Put together, our findings from analyzes of the thematic curriculum standards suggest that by the time children are joining primary, they are required to have already developed some foundational language and numeracy competences that the lower primary curriculum will seek to build on. This synthesis is quite obvious when you consider the finding that the English strand completely omits development of critical foundational language competences relating to sounds, phonics, the alphabet, phonemes and word and sound patterns. Considering the extreme inequality gaps in pre-school attendance in Uganda today, these findings portray an over-ambitious national curriculum standard that likely makes it hard, from early on, for the majority of children to develop the basic foundational skills that would enable them to enjoy learning and be able to stay at it.

The rest of this paper is organized as follows. The contextual background to basic education in Uganda and a description of the basic education curriculum in Uganda are given in section 2. Section 3 makes a case for and explains the SEC methodology relative to this study. We present our findings in section 4, followed by a detailed discussion of our findings in section 5. Section 6 concludes.

2.0 Contextual background

While presenting for public debate the official Government of Uganda (GoU) position on the proposals made in the Education Policy Review Commission (EPRC) report, in what has famously become known as the 1992 Government White Paper (GWP), then minister of education and sports clearly articulated the aspiration of Uganda's education system: "Uganda must henceforth seek to establish the highest quality of education possible as the basis for fundamental change, revolution and national development" (Government of Uganda, 1992). Twenty five years later since that visionary statement, education policy makers in Uganda, and generally in most of the developing countries of Sub-Saharan Africa (SSA) are still puzzled about how to achieve this vision. We start by defining basic education in the Ugandan context, describing its' recent history and identifying its' challenges, and then dwell on the concept of curriculum mainly at primary school level**.**

2.1 Uganda's basic education

The GoU defines basic education as "the minimum education package of learning made available to each individual or citizen through phases of formal primary education and non-formal education system(s) to enable him or her be(come) a good and useful person in society" (GoU, 2008)). Put differently, basic education lays the foundation or the "infrastructure" within which reading, writing and numeracy skills that are needed for further learning are developed (Ezati, 2016). Basic education in Uganda constitutes the first 12 years of formal schooling with three levels, pre-primary for at least one year, primary for seven years and lower secondary for four years. Pre-primary schooling is recognized as the first level of education in Uganda, targeting children aged between three and five years. Predominantly, pre-primary education takes place in ECD centers, over eighty percent of which are privately owned (Ejuu, 2012; MoGLSD, 2013), and is therefore not tuition-free. A nationally recognized learning framework that prescribes content to be learned by three-to-six year old children attending the ECD centers has been in existence since 2005. Recent evidence from Twaweza's Uwezo household-based annual learning assessments however, indicate that only about 27% of 3-5 year old children in Uganda are attending pre-primary education (Uwezo, 2016). At age six children are required to enroll into primary school, which lasts for seven years and has three distinct learning cycles – lower primary grades one to three, transition grade four and upper primary grades five to seven. Since 1997, the GoU has been running a universal tuition-free primary schooling model. However, a significant minority of about 20% of the primary school children in Uganda attend for-fee private primary schooling (MoESTS, 2014). At the end of the seventh grade, children sit for a high stake national examination that determines entry into lower secondary school.

Uganda's formal education system is entwined with the introduction of christianity by white missionaries in 1877 (Ssekamwa, 1997). With time however, some aspects of the education system have progressively been changing in response to the prevailing development challenges, while others have remained and continue to puzzle policy makers. Post-independence, several reforms of Uganda's education were undertaken mainly aimed at addressing a number of gaps. During the colonial times, the Phelps-Stoke commission of 1924/25 was the first of four commissions appointed to review and propose recommendations on various aspects of Uganda's education. Immediately after gaining independence, the GoU set up the Castle commission in 1963 and tasked

it to undertake a comprehensive review of the education system. The Education Policy Review Commission (EPRC) was set up in 1987 and tasked to inquire into the policies governing education in Uganda (GoU, 1992). In its' 1989 report, the EPRC criticized the existing education system's inability to relate educational activities to the community and the people, thus promoting an 'exclusively literary' or elitist education model (Ssekamwa, 1997; Ezati, 2016). One common theme kept appearing in all the proposals of the three commissions, that is, the need to integrate practical and vocational skills into the primary and secondary education curricula so as to ensure graduating students were more productive and would meet the existing labor demands. One of the most important proposals made by the EPRC was to require that GoU abolishes the mandatory payment of tuition fees as a pre-condition for access to primary schooling. The GoU consequently introduced the Universal Primary Education (UPE) policy in 1997, which led to immediate dramatic increases in enrolment and attendance, culminating into extremely overcrowded classes, especially in the lower primary grades (Deininger, 2003).

Whereas access to primary education has significantly increased and the education sector is now allocated a significant proportion of the national budget resources, the extremely low quality of learning taking place in Ugandan classrooms today presents a real threat to the country's future development prospects. Several studies have been conducted in the recent past, showing that even within the East and Southern African region, the performance achievements of Ugandan children and their teachers are significantly lower than those of other countries, including Kenya and Tanzania (Byamugisha & Ssenabulya, 2005; Ward. M, et.al. 2006; Lucas. M. Adrienne, et.al. 2013; USAID/RTI, 2014; Jones, 2015; Rose Pauline & Alcott Benjamin, 2015; Atuhurra, 2016; & Uwezo, 2016). With low learning outcomes being strongly linked to incidences of early dropout from school it is little wonder primary school enrollment figures are currently stagnating, survival to the last grade is a measly 32%, and Uganda currently lags in the fourth from bottom position on school completion in SSA (GPE, 2015). In their highly influential study of children's learning profiles in South Asia and Africa, Pritchett and Beatty (2012) find that even after several years of instruction in school the majority of children are still devoid of foundational skills of counting, reading and writing. They explain this shocking result as arising from overambitious curricula that make it impossible, from early on, for children to keep pace. To this end, our study builds on Pritchett and Beatty (2012) by analyzing, first for lower primary grades, the critical curriculum effectiveness aspects including scope, sequence and alignment.

2.2 The Primary school curriculum

We define curriculum as the prescribed content to be taught and learned, which provides the basis for assessment in form of tests (Twaweza, 2015b). Consistent with this definition, Porter (2004) characterized the curriculum into four types - the intended or prescribed, the enacted or taught, the assessed, and the learned curricula. The Intended curriculum refers to the one that is prescribed in the content standards, which states what learners must know and be able to do at a particular point in time. The enacted curriculum is what the teacher delivers and how he or she delivers the content to learners in a learning environment. The assessed curriculum refers to the content on which students are examined or tested to establish learned competences. Finally, the learned curriculum is what the learner knows and is able to do in a given class/grade level. To understand the relationships between these four types of curriculum we start with the intended which provides the

instructional target for what is actually taught. The taught or enacted curriculum is the best predictor of students' achievement levels in tests. From these achievement scores that children obtain on the tests we are able to determine the learned curriculum. The content of these tests represent the assessed curriculum. In a standards-based system, the alignment between these four types is of utmost importance since it forms the basis for assessing curricula effectiveness (Case et al., 2004; Porter, 2004; Smithson J, 2013).

In a detailed review of the recent history of curriculum reforms in Uganda, Ezati (2016) identifies five primary curriculum reform documents – 1965, 1967, 1990, 1999 and 2007-2010. The author notes that in all the five reform documents, only minimal changes were made on critical curriculum aspects – scope, sequence, relevance and language of instruction. Although the number of subjects covered in primary reduced from the 12 reflected in the 1967 curriculum to the 9 reflected in the 2007-2010 curriculum, Ezati (2016) notes that these changes were mostly cosmetic, characterized by repackaging and merging of the same content, thematic formatting and subject re-contextualization. The current primary curriculum is organized in three distinct cycles – the lower primary theme-based curriculum for P1–P3[9], the transition to subject-based P4 curriculum, and the upper primary subject-based curriculum for P5-P7 (NCDC, 2006a; NCDC, 2006b). In previous years, a number of studies had described the primary school curriculum in Uganda as too theoretical, pays scant attention to the development of competencies and skills, generally out of date, overloaded and not learner-centred (Ssekamwa, 1997; Najjumba & Marshall, 2013; Ezati, 2016). In most of these studies, the measures used to assess curriculum overload included the number of subjects, volume of content, teaching time and the precision of the guiding notes to teachers (APPA, 2014). The thematic curriculum, introduced since 2007, is competence-based, adopts a learner-centered approach to teaching and assessment, reduced the number of subjects from twelve to nine, organized the learner content into themes of immediate meaning and relevance to the learner and produced accompanying teacher guides and resource books for lower primary. A field investigation of the actual implementation of the thematic curriculum however, found that teachers were struggling to actualize it and had grown frustrated by its' inappropriateness to the actual situation they faced in the classroom (Altinyelken, 2010). Some of the mentioned challenges that teachers highlighted included insufficient time to cover the prescribed content, controversies arising from the lack of a widely accepted local language to be used as the medium of instruction in some areas, overcrowded classrooms that made group work difficult, lack of knowledge about how to practically conduct continuous assessment for each child, and lack of teaching and learning aids. Pritchett and Beatty (2012) highlight a major consequence of such overambitious curricula in developing countries of South Asia and Africa, as the shockingly flat learning profiles seen even after children have undergone several years of instruction.

[9] The content of the thematic curriculum is organized into twelve themes - our school, our home, our community, the human body and health, weather, accidents and safety, living together, food and nutrition, transport, things we make, our environment, and peace and security.

3.0 Methodology: Surveys of Enacted Curriculum

Li and Sireci (2005)'s detailed review of curriculum alignment studies identified five most prominently used models for curriculum analysis - the Webb model (1997), the La Marca model (2001), the Achieve model (2001), the Surveys of Enacted Curriculum (SEC) model (2002) and the Council of Basic Education (CBE) model (2002). While the other four models are categorized as high complexity models due to the relatively high number of criteria they employ in their analyzes, the SEC model is a moderate complexity model which uses mainly two criteria, content topics and cognitive demand[10]. Both the expert-based activities of judging the content embedded in the standards and assessments, and the detailed analyzes of the data that is generated by experts and teachers are based on application of a simple Microsoft spreadsheet software – Excel. Li and Sireci (2005) highlight that the SEC model has been widely used to produce alignment analyzes between standards, assessments and instruction across eleven states and four large urban districts in the United States. Utilizing a common two-dimension content matrix that allows analytical comparisons across teachers, schools, districts and states, the SEC represents a robust, valid and reliable framework providing research-based data collection, analysis and reporting tools for the description of the intended and assessed content, and the provision of information on teachers' classroom instructional practices and content delivery (Porter, 2002; Case B. et al., 2004). In other studies, the SEC approach has been described as the most predictive model of student achievement scores, and the only model that provides alignment indices at the taught or enacted curriculum level (Case & Jorgensen, 2004). For the purposes of this study in which we analyze the over time cumulative growth of content, cognitive demands and overall emphasis in lower primary grades, the SEC provides us with the clearest and most concise articulation.

The SEC model presupposes the existence of a comprehensive multidimensional subject-specific taxonomy for each of the subjects or learning areas to be analyzed, which systematically lists content in form of topics and sub-topics, and respective cognitive demand levels for each grade. Such a taxonomy forms the base reference document for coding topics/subtopics and rating cognitive demand levels that are embedded in the curriculum documents under review. For each subject or learning area, the review is undertaken by a team of three or more highly experienced and well trained individuals who are expertly knowledgeable in the subject matter. Each member of the expert team works independently, applying their expert judgment to make a call that they record in the two-dimension content matrix of topic/subtopic and cognitive demand level for each competence or learning objective. This call is in form of a descriptive topic number code combined with a letter code that identifies the specific cognitive demand level. The SEC model identifies five levels of cognitive demand or expectations for student performance[11] - memorize or recall; perform procedures; generate or demonstrate conceptual understanding; analyze, conjecture, prove or hypothesize; and synthesize, make connections, integrate, apply concepts or solve non-routine

[10] Whereas the content topics/sub-topics relate to what the student needs to know, the cognitive demands are specific descriptions of performance expectations for each learning objective or competence to be achieved, i.e. what students should be able to do (Smithson, 2015). Five categories of student performance expectations (cognitive demand) are employed by the SEC model: **B** – Memorization or Recall; **C** – Perform Procedures; **D** – Conceptual understanding; **E** – Analysis, conjecture and proof; and **F** – Synthesis, integration and novel thinking.

[11] The detailed descriptions of each of the five cognitive demand levels are reflected in the cognitive demand matrices for Mathematics and English shown in annex A1 and annex B1 respectively.

problems (Smithson, 2015). After completion of their individual-level independent reviews, subject team discussions are held in which each expert justifies their calls for each learning objective or competence coded. Whereas there is no requirement for a team consensus, experts may change their calls if they are convinced that their original coding may not have been appropriate for the specific learning objective. A robust statistical algorithm is used to average the expert-generated data sets of topic/subtopic and cognitive demand, and thus obtain descriptive content maps, charts and other marginal measures that explain curriculum alignment.

Two levels of SEC analysis are possible, coarse grain and fine grain analysis. Coarse grain analyzes are summative or evaluative analyzes that portray relative emphasis on topics and cognitive demand. Such analyses are useful for giving a general overview of the distribution of content across topics and performance expectations. On the other hand, fine grain analyzes are formative diagnostic analyzes at the more micro subtopic level. After obtaining the summative alignment picture, the fine grain maps are used to point to specific subtopic areas that need to be addressed in order to improve alignment (Smithson, 2013). Three-dimensional content maps that visually display informative descriptions of the content that is embedded in the curriculum documents constitute the main output of SEC analysis (Smithson, 2015). The three axes represent topics or sub topics on the Y-axis, performance expectations or cognitive demands on the X-axis, and contour lines and color bands depicting the level of emphasis on the Z-axis. Two more outputs are available from the SEC analysis. First, the alignment analysis summary table showing both the overall alignment index (OAI) and its' constituent three marginal alignment indices - topic coverage (TC), cognitive complexity (CC) and balance of representation (BR). The OAI, TC, CC and overall BR measures are interpreted based on the recommended SEC threshold of 0.5 within the range from zero to one. Zero represents a condition of no alignment or perfect misalignment, and one refers to a situation of perfect alignment. The topic-level BR measures however, reflect perfect balance in emphasis at 0.00 (Smithson; 2015). Second, the marginal charts that make it easy to assess relative emphasis on a two-dimensional display across topics/subtopic and cognitive demand.

3.1 How was SEC contextualized in Uganda?

Twaweza, a civil society organization, works on enabling children to learn, citizens to exercise agency and governments to be more open and responsive in Tanzania, Kenya and Uganda (Twaweza, 2015(a)). Twaweza adopted the SEC approach to its' work of analyzing the effectiveness of the basic education curricula in all the three countries of East Africa. In each of the three countries, in the fourth quarter of 2015, Twaweza conducted consultative forums at which the concept of curriculum effectiveness was discussed, and soon led to the composition of panels of curriculum experts for each country. In Uganda, the panel of eleven experts were drawn from two national universities, the national curriculum body, primary teacher colleges, schools and the school inspectorate department of the education ministry[12]. The members of the panel of experts were oriented and trained on the SEC, with the Wisconsin Center for Educational Research

[12] The detailed composition in Uganda's case was as follows: three experts from the National Curriculum Development Centre (NCDC), one expert from Makerere University's school of education, one expert from Kyambogo university's teacher education department, one expert from the ministry's directorate for school inspections, two experts from primary schools, one expert from Nakaseke core primary teachers' college and two experts from Twaweza East Africa.

(WCER) directly training the country team leads who in turn trained the other members of the panel. The experts were then organized into four core subject teams - mathematics with three experts, English with two experts, Science with three experts, and Social studies with three experts. Whereas SEC recommends a minimum of three experts per subject, we were financially constrained to add an extra expert to ensure the English team met this minimum requirement.

The primary school curriculum in Uganda is organized in three distinct cycles- the thematic curriculum for lower primary grades one to three, the transition subject-based grade four curriculum, and the upper primary subject-based curriculum for grades five to seven. There are four core subjects assessed at the end of the seven-year primary cycle. Since competences for integrated science and social studies are reflected in the standards starting in grade four, we focus our discussion in this paper on the analysis and findings from the lower primary mathematics and English strands.

Since our best efforts to locate an existing subject-specific taxonomy proved unsuccessful for all the four core subjects, the subject expert teams were tasked to review and adapt the USA's K12 subject taxonomies to fit the Ugandan context. During this contextualization process, a number of topics and subtopics appearing on the K12 taxonomy were dropped and very few (if any) added. Because of the highly context-specific nature of the taxonomy for Social Studies, the K12 taxonomy was basically used as a mere guide to developing a completely new Social Studies taxonomy for Uganda. These now contextualized taxonomies were adopted and thus formed the basis for the task of coding and rating that the experts embarked on[13]. The contextualized taxonomy for English language at primary has eighteen topics - phonemic awareness, phonics, vocabulary, text and print features, fluency, comprehension, critical reasoning, author's craft, writing processes, elements of presentation, writing applications, language study, listening and viewing, speaking and presenting, forms of text, genre, sources of text, and choice. The taxonomy for mathematics on the other hand, has thirteen topics - number sense, operations, measurement, consumer applications, basic algebra, advanced algebra, geometric concepts, advanced geometry, data displays, statistics, probability, analysis, and special topics[14].

Consistent with the recommended SEC procedures, each panelist reviewed the content in the curriculum standards individually and selected the most appropriate code(s) and cognitive demand levels for each competence listed in the standards. Subject team discussions were then held at

[13] The contextualized taxonomies for mathematics and English are shown in annex A2 and annex B2 respectively.

[14] The contextualized taxonomy for integrated science has sixteen topics - cross-cutting themes; science and technology; science, health and environment; measurement and calculation in science; components of living systems; botany; animal biology; human biology; reproduction and development; ecology; energy; motion and forces; electricity; properties of matter; earth systems; meteorology; and fresh water science.
The taxonomy for Social studies on the other hand, has twenty five topics - social studies skills; human culture; technological change; multicultural diversity; social problems; foundations of government; principles of democracy; constitutionalism; political and civic engagement; managing resources; how markets work; economic systems; economic interdependence or globalization; personal finance; map skills; places and regions; physical geography; human and cultural geography; human and environmental interactions; agricultural practices in East Africa; People of East Africa; History of Africa (people, events and documents); foreign influence in Africa; nationalism and the road to independence; and nature of vegetation.

which the experts justified their coding and rating, and made independent individual decisions on whether or not to alter their original calls. For each of the four core subjects taught and examined at primary school level, the coding was done for each competence listed in the curriculum standards for all the seven grades, and for the end of primary cycle national examinations for the three years 2013, 2014 and 2015. For content that may well be explained across several topics and/or with varying cognitive demand levels, experts were allowed to enter up to six combinations for competences in the curriculum standards, and up to three combinations for question items in the primary leaving examinations (PLEs).

Based on our experience and for purposes of making a more efficient use of the SEC model to improve curriculum alignment in East Africa, we would strongly recommend that a comprehensive review of the K12 subject taxonomies be undertaken with a view to come up with nationally agreed subject taxonomies covering the 12 years of basic universal education. Second, we would recommend that subject expert teams be composed with each team having at least four members so as to facilitate a more nuanced discussion and increase inter-rater reliability levels. The subject team members ought to meet the requirement for broad representation and yet possess the relevant breadth and depth of subject knowledge which is critical when appreciating the bigger conceptual issues around content.

4.0 Findings

As was explained in section 2.2, the content for all the three grades in lower primary is organized into 12 themes that offer immediate interest/meaning and relevance to the learner, and is delivered in a local or familiar language. The goal at this level is to develop basic competencies in literacy, numeracy and other life skills (NCDC, 2006a). In this section, we present findings from the analyses of the lower primary curriculum standards. Derived from the expert-generated two-dimensional data matrices depicting topics/sub-topics and learner performance expectations as was explained in section 3.1, our findings touch on curricular scope, sequence, relevance, performance demand and alignment aspects in the three lower primary school grades. They paint a descriptive picture of the content that is embedded in the standards. We present first, the findings from the analysis of the mathematics learning area/strand and then the findings from the English strand.

4.1 Mathematics in lower primary

We use content analysis maps at both topic (coarse grain) and sub-topic (fine grain) levels, relative emphasis charts, and alignment tables to depict the summative picture of the content in the curriculum standards. The content maps represent a three-dimensional topographical display of topics or sub-topics on the vertical axes, the five levels of learner performance expectations on the horizontal axes, and the relative emphasis for each intersection of topic or sub-topic and performance expectation as the third dimension represented by contour lines and various color bands. The specific data points can be found at the intersection of the topic and cognitive demand level.

Figure 1(a) presents the topic-level coarse grain maps for mathematics content for the three grades P1, P2 and P3. All three maps display a fairly complex array of topics covered. Throughout the

three classes, as is shown in the darker parts of each of the maps in this figure, there are three major topics emphasized – 'number sense', 'operations' and 'measurement'. 'Data displays' and 'special topics', in this case referring to "sets", are also covered but given comparatively lesser emphasis. Minimal emphasis is reflected for 'basic algebra' and 'geometric concepts' in lower primary grades. For further exposition, we will focus on the three main topics of emphasis. At this point, it is worth mentioning that all the three displays present a generally similar structure, in fact the overall alignment index summaries for P1/P2 and P2/P3 are 0.56 and 0.46 respectively. These values are pretty close to the 0.5 alignment threshold that SEC recommends as reflecting optimal alignment.

Table 1 shows the alignment summary tables for P1/P2 and P2/P3. Using the summary measures in this table we can form a general picture of the relative emphases put on specific topic areas and cognitive complexities across the respective grades. Except for the balance of representation (BR) measures, the rest are interpreted in a similar manner – the closer the measure is to 1.00 the more perfectly aligned it is across the two grades, implying that an alignment index of 0.01 suggests near imperfect alignment. The BR measures reflect perfect balance in emphasis between the two grades at 0.00. The -0.13 BR measure for number sense therefore, means that relatively speaking, number sense is emphasized less in P1 than in P2. On the contrary, the 0.38 BR measure for number sense indicates that this topic is emphasized more in P2 than in P3. Adding these two summary statements reveals that number sense as a topic is mostly emphasized in P2 than either of P1 and P3. However, the overall BR measure has been converted back to the 0-1 metric and is therefore, interpreted in a similar manner as the other three overall measures. Using these overall BR measures therefore, the 0.85 and 0.60 measures indicate optimal balance in emphasis across all the topics covered in the three lower primary grades. The marginal values of relative emphasis of each topic are shown in figure 1(b). From this figure, we find that number sense is the most emphasized topic in P1 and P2. In P3, measurement and operations are more emphasized than number sense. Figure 1(c) on the other hand, shows relative emphasis of each cognitive demand level. The charts in figure 1(c) show that in all the three lower primary classes, the thematic curriculum requires that most emphasis be placed on developing children's computational proficiency and ability to demonstrate understanding of mathematical ideas.

A more detailed diagnostic analysis focusing on the sub-topics within each of the topics is possible. We analyze the fine grain content maps and their respective marginal charts to establish relative emphases of subtopics and cognitive demand levels[15], starting with number sense (appendix A). For all the three grades, as is depicted in figure 2(a), greater emphasis is put on developing competences in 'whole numbers and integers'. While in P1 and P2 moderate emphasis is also put on 'real and rational numbers' and 'number comparisons', in P3 'place value' and 'operations' are more emphasized. In all three grades, greater emphasis is placed on developing computational procedures and demonstration of conceptual understanding of ideas than to recall or memorization of basic mathematical facts as is shown in figure 2(b).

Moving on to Operations, all the three grades emphasize three subtopics, 'add/subtract whole numbers', 'multiply whole numbers' and 'represent fractions'. Additionally, grades 2 and 3 cover

[15] Fine grain subtopic level content maps are shown in the appendices A-F

‘division of whole numbers and integers’. The fine grain maps for all three grades (appendix B) indicate that add/subtract whole numbers and integers in P1 aims to develop both performance of computational procedures and demonstration of understanding. Figures 3(a) and 3(b) show the relative emphases on subtopics and cognitive demand levels under this topic. Multiplication of whole numbers is handled at recall level in P1 and on to performing procedures and developing understanding in P2. Divide whole numbers is emphasized at perform procedures starting in P2 and at both perform procedures and demonstrate understanding at P3. We find that add/subtract whole numbers receives a disproportionately greater emphasis in P1 as opposed to the other three sub-topics, but also as opposed to its’ coverage in the subsequent two grades P2 and P3. At both P2 and P3, add/subtract whole numbers remains most emphasized although the distribution of emphasis across the four subtopics is less disproportionate. In P3, representation of fractions receives a little lesser emphasis than in P2. In P1, greater emphasis is placed on developing competences that demonstrate understanding of ideas followed by performance of procedures. In P2 and P3, surprisingly, more emphasis is placed on performance of computational procedures followed by demonstration of understanding.

The third most emphasized mathematics topic in lower primary school is measurement. For all the three grades, this topic receives the most varied and complex coverage both in terms of the required subtopics to be covered[16] and the development of learner performance expectations (as can be seen from figures 4(a) and 4(b), and appendix C). With major emphasis in all the three grades devoted to developing competences in solving novel problems, this topic is the most challenging that children in lower primary are required to engage with. However, since solving novel problems involves application to real world situations, the challenges posed by this topic might motivate children to exert more effort and enjoy their discoveries. Although P3 covers an additional two subtopics – ‘area and volume’, and direction, location and navigation’ – the majority of the subtopics are covered in all the three grades.

Sets are reflected under special topics in our contextualized taxonomy. This topic also receives considerable emphasis in all the three classes of lower primary, thereby developing children’s competences and abilities to sort objects, identify and compare different types of objects, form and classify objects by size, color, category, number, et cetera. The greatest emphasis is in P1 where children’s learning is focused mainly on performance of procedures. This remains the emphasis all through the three classes.

To sum up our findings on mathematics curriculum standards in lower primary grades 1-3, we see that similar topics are emphasized in the three grades and largely the same performance expectations are emphasized throughout, mainly performance of computational procedures and demonstration of conceptual understanding.

4.2 English in lower primary

In this section, we use content maps, relative emphasis charts and alignment tables to explain the findings from analyzes of the content embedded in the English strand of the thematic curriculum

[16] The subtopics include use of measuring instruments, the metric system, length and perimeter, mass/weight, temperature and time, money, calendar, capacity, and distance.

standards covering the three lower primary grades, P1-P3. As can be seen from the topic-level coarse grain maps in figure 5(a), 'speaking and presenting' and 'elements of presentation' are the only two topics that are consistently emphasized in all three lower primary classes. Two more topics are covered in P1, 'critical reasoning' and 'language study' of which critical reasoning is dropped in P2 and two new topics emphasized instead – 'text and print features' and 'comprehension'. In P3 however, 'critical reasoning' is emphasized again and instead 'language study' gets very minimal emphasis. Only one new topic is introduced in P3, 'writing applications'. In summing up the topics of dominant emphasis in each grade (refer to figure 5(b)), it is clear that 'speaking and presenting' and 'language study' are the most emphasized topics in P1 and P2. Additionally for P2 however, 'comprehension' and 'elements of presentation' also receive considerable emphasis. For P3, the standards emphasize mainly three topics – 'speaking and presenting', 'comprehension' and 'writing applications'. From this summary, it is clear that three topics form the core focus of the lower primary English strand – speaking and presenting, language study, and comprehension. Regarding the general performance expectation levels reflected in the coarse grain maps, we find that P1 content emphasizes mostly the ability to demonstrate connections. A similar focus is maintained in P2 but with an even more demanding performance expectation of analysis or conjecture when developing competences in the newly introduced topic, 'comprehension'. The P2 performance expectations structure is maintained in P3. A descriptive summary picture of the relative emphases put on specific topics and cognitive demand levels for the three classes is shown in table 2 – the alignment summary table for English in P1/P2 and P2/P3. From this summary table, let's compare the relative emphases on topic coverage for 'language study' in P1/P2 and P2/P3 – the respective alignment measures are 0.50 and 0.15. The higher 0.50 index for P1/P2 implies that similar sub-topics receive the most emphasis in both grades – in this case it relates to mainly 'standard and non-standard language usage'. On the other hand, the alignment measure is quite low for P2/P3 mainly because a comparatively much lower emphasis is put on the same sub-topic in P3.

Before we delve into the diagnostic fine grain analyzes of the sub-topics that receive most emphasis in the thematic curriculum standards[17], we note that the standards do not require teachers to spend time on developing language competences in two critical topics, 'phonics' and 'phonemic awareness', as these receive no attention in all the lower primary grades. The omitted sub-topics falling under these topics include 'blending sounds', 'sound patterns', 'identifying syllables', 'rhyme recognition', 'phoneme isolation', 'the alphabet', 'consonants and vowels', 'patterns within words', et. cetera. Also of importance to note is that throughout the three grades, the coarse grain content maps reveal that very minimal emphasis is focused on developing 'recall/memorize' and 'evaluate/integrate/non-routine' cognitive demand levels (figure 5(a)).

For the fine grain analyses, we focus on the seven topics that form the majority of the emphasis in P1-P3, starting with 'speaking and presenting'. As can be seen from figure 5(b), this topic is the most emphasized in all the three grades. As is depicted in figure 6(a), P1 and P3 mostly emphasize 'public speaking and oral presentation' competences while the focus in P2 is mostly on developing 'debate and structure of argument' competences. Two more subtopics are covered in all three

[17] Fine grain maps for the three most emphasized topics are shown in Appendix D, E and F.

classes, 'diction, tone, syntax, convention, and rhetorical structure', and 'conversation and discussion'. While all three classes put most cognitive demand emphasis on demonstrating understanding, P1 and P2 also focus on performing procedures – which is clearly not the case in P3 (see figure 6(b)).

'Language study' is the second most emphasized English topic in P1 and P2. Figure 7(a) reveals that 'standard and non-standard language usage' is the most important sub-topic and is given emphasis in all the three grades. With a minor exception in P2 where some recall skills are also emphasized, the curriculum standards require that all the three classes predominantly emphasize cognitive abilities targeted at generating understanding (see figure 7(b)). In addition to language usage, P1 also emphasizes 'syntax and sentence structure' and 'grammatical analyses'. In P2 however, additional emphasis is put on 'spelling' and 'capitalization and punctuation'.

'Comprehension' is covered only in P2 and P3. The relative emphasis areas for both subtopics and cognitive demand levels are shown in figure 8. Four sub-topics are covered in both grades, 'main idea', 'descriptive elements', 'narrative elements' and 'interpreting maps, graphs and charts'. Two more subtopics are covered in P2, 'sentence' and 'technical elements', of which sentence comprehension comprises the overall majority emphasis in this grade and is not covered in P3. In P3, four new additional subtopics are emphasized, 'strategies', 'word meaning from context', 'expository or informational elements' and 'metacognitive processes'. Whereas relatively moderate cognitive demand emphasis is given to ability to demonstrate understanding in P2 and to evaluate and integrate in P3, the predominantly targeted overall cognitive demand level for comprehension is the ability to analyze and investigate.

'Elements of presentation' is covered in all the three grades, but mostly in P2 (see figure 5(a)). Although two subtopics are covered in P1, 'purpose, audience and context' and 'style, voice, technique, and use of figurative language', only the latter is commonly emphasized in all the three grades[18]. In P1, the main cognitive demand level targeted is analyze and investigate and only minimum emphasis is put on performing procedures and demonstrating understanding. Two new additional sub-topics are covered at mainly demonstrate understanding level in P2, 'main idea' and 'writing conventions', of which the former comprises the majority focus in this grade. Likewise in P3, a new sub-topic, 'organization', that comprises the majority focus at this grade is emphasized at evaluate/integrate level of performance expectation.

'Critical reasoning' is predominantly covered in P1, and to a minimal extent in P3 (see figure 5(a)). In P1, the focus is mainly on three subtopics, 'fact and opinion' – memorize, 'appealing to authority, reason and emotion' – perform procedure, and 'validity and significance of assertion or argument' – conjecture or analyze. By far however, the main focus for this topic is on memorization of facts and opinions.

'Text and print features' is covered in P2 and P3, and emphasizes only one subtopic - 'graphical elements', which is targeted at demonstrate understanding. The final topic we discuss, 'writing applications', is covered only in P3. All the six sub-topics covered under this topic emphasize

[18] Due to space considerations, the diagnostic fine grain subtopic-level content maps for elements of presentation, critical reasoning, text and print features, and writing applications will be availed only on request.

mainly the performance level of demonstrating understanding. One sub-topic, 'narrative' is given the greatest emphasis at this level.

An overall summary of our findings from analysis of the curriculum standards English strand in lower primary grades 1-3 is that a number of foundational language topics and sub-topics are not covered and the majority of learner performance expectations for this strand are intended for developing the ability to demonstrate understanding and to analyze and investigate.

5.0 Discussion of findings

Given the critical foundational roles played by cognitive and other life skills-enhancing interventions in early childhood, it is obvious that the thematic curriculum represents the most important early education policy instrument for the achievement of individual, community and national development aspirations in Uganda. This study was motivated by two critical facts about early childhood learning in Uganda. First, a very small minority of three-to-five year old children attend pre-primary schooling, more than seventy percent go straight from home to grade one at the nearest public primary school when aged six. Second, the majority of primary school-going children in Uganda fail to acquire basic learning competences of reading and counting even after several years of attendance, only until grade five do we see at least half of the children attain full competence at grade two level (Uwezo, 2016). In this study, we utilized the SEC model to describe the content that is embedded in the thematic curriculum standards for the first three primary school grades. We summarize and discuss two main findings from this study.

From early on in the study, it became clear that whereas curriculum standards that prescribe content to be taught in pre-primary, primary and lower secondary schools exist, the country lacks well thought comprehensive subject-specific taxonomies for each of the learning areas covered under basic education in Uganda. In order to achieve the broad subject-level basic education goals, such base reference documents would systematically list the topics, sub-topics and performance expectations to be covered in each learning cycle or grade level. This multidimensional specification of content coverage is required in order to attain planned sequential progress on content, ensure fit across grades and cycles, and eliminate any potential gaps and duplications along the way. The 0.56 overall alignment measure for mathematics between P1 and P2 (refer to table 1) is well above the SEC threshold of 0.5. Whereas such a measure would be highly desirable if we were comparing standards to assessments for the same grade, in this case the comparison between content intended for sequential grades implies little progressive learning between the two grades. More evidence of a non-systematic approach to content coverage across grades is also evident in the English strand: Whereas 'critical reasoning' receives about 15% and 8% marginal emphases in P1 and P3, it is completely dropped in P2 (see figures 5(a) and 5(b)). The inconsistence in the coverage of this topic is seen in the fine grain analyzes of the sub-topics covered across the two grades – whereas in P1 the sub-topics 'fact and opinion' and 'appealing to authority, reason and emotion' are covered at 'memorize or recall', the same are covered next in P3 at 'evaluate or integrate'. This significant jump from a low-order to the highest-order thinking skill level interspersed with a whole year of non-engagement with the same topic is likely to cause great difficulty for children's ability to follow and understand the content. A comprehensive

review of the K12 subject taxonomies aimed at adaptation to fit the Ugandan basic education context might present the most effective approach towards filling this gap.

The second major finding from this study highlights the interaction between the class compositional realities in most UPE schools and the prescribed content and approach of the thematic curriculum. In most schools, the lower grades are the most overcrowded with the class size for P1 usually exceeding 100 pupils. Previous studies have highlighted overcrowding and mixed peer ability levels as major constraints to effective learning in UPE schools (Nakabugo, et al. 2008; Jones, 2015). Due to the various extreme overcrowding effects in lower primary grades, Altinyelken (2010) notes that teachers are unable to implement the continuous individualized assessment and child-centered pedagogical approaches of the thematic curriculum. Given this context, the finding that the thematic curriculum places little to no emphasis on development of low-order 'memorize, recall and recite' skills and instead focuses more on 'perform procedures', 'conceptual understanding' and 'analysis, conjecture and proof', is quite surprising. Additionally for the English strand, we found that critical foundational language competence topics such as 'phonics and phonemic awareness' were completely omitted from the thematic curriculum. Given the very small proportion of children exposed to pre-school learning before joining primary, the majority likely lack the required foundational competences to effectively engage with the content of the thematic curriculum. In the mathematics strand, the standards require that children joining P1 are taught to sort objects, sequence numbers, form sets, arrange numbers in increasing order, and match numbers and objects. Whereas these competences may be grasped quite naturally by children who previously attended pre-school and therefore learnt to sing number songs, recite number names, rote count up to 20, recite addition and subtraction rhymes and sing increase and decrease number songs, these tasks likely represent extremely difficult early hurdles to learning basic numeracy for the majority of the children in P1. Similarly for the English strand, it is likely quite difficult for children who have not learned to imitate sounds, match letters with sounds, repeat sounds in their order, make words using sound, repeat simple riddles, make gestures, coordinate eye and hand movements, and sing and move with the rhythm, to speak in complete sentences, express feelings in words, tell and retell simple stories, recite tongue twisters, use appropriate language to peers and superiors, and make up stories.

A recent study that assessed the potential cost-benefit ratios of pre-schooling in Uganda proposed three strategies that would enable the expansion to universal pre-primary education in an affordable manner: First, there is need to upgrade the existing capacities of the current pre-schools and observe age limits, then to enter into a pact for ECD that involves division of roles and responsibilities among various players, and lastly the implementation of a small per-child subsidy from government (Behrman & Ravens, 2013). In the very short-term though, and in line with what a significantly increasing number of primary schools is currently doing, it makes practical sense to accept the children who seek enrolment when still aged five and to take them through one year of learning and developing foundational competences based on the NCDC's pre-school needs-based learning framework, before they can formally join P1 and become exposed to the lower primary thematic curriculum.

6.0 Conclusion

In this study, we have conducted a detailed analysis and given a clear description of the prescribed content of the thematic curriculum for lower primary school grades in Uganda. We adapted and applied the SEC approach to the Ugandan context for the first time, and unearthed evidence-based policy-relevant findings critical for improving learning outcomes at primary school level. Whereas this study's findings are limited by its' inability to establish alignment between the intended, taught and assessed curricula, the well-articulated findings relating to a comprehensive subject-level taxonomy and the nature of curriculum over-ambitiousness at lower primary level are nevertheless quite important for improving curriculum effectiveness and overall primary education in Uganda.

Table 1: Alignment analysis summary table – Mathematics P1-P3

Math Primary 1 TO: Math Primary 2	**Alignment**	**Balance of Representation**	**Topic Coverage**	**Cognitive Complexity**
Number Sense	0.72	-0.13	0.78	0.85
Operations	0.49	0.03	0.62	0.47
Measurement	0.46	0.01	0.56	0.78
Overall	**0.56**	**0.85**	**0.64**	**0.76**
Math Primary 2 TO: Math Primary 3	**Alignment**	**Balance of Representation**	**Topic Coverage**	**Cognitive Complexity**
Number Sense	0.58	0.38	0.61	0.84
Operations	0.80	-0.11	0.90	0.38
Measurement	0.52	-0.22	0.64	0.75
Overall	**0.46**	**0.60**	**0.52**	**0.54**

Table 2: Alignment analysis summary table – English P1-P3

English Primary 1 TO: English Primary 2	**Alignment**	**Balance of Representation**	**Topic Coverage**	**Cognitive Complexity**
Speaking and Presenting		0.16		
Language Study		0.09	0.50	0.13
Comprehension		-0.22		
Overall	**0.28**	**0.58**	**0.36**	**0.46**
English Primary 2 TO: English Primary 3	**Alignment**	**Balance of Representation**	**Topic Coverage**	**Cognitive Complexity**
Speaking and Presenting		-0.02		
Language Study	0.00	0.21	0.15	0.54
Comprehension		-0.01		
Overall	**0.18**	**0.61**	**0.23**	**0.47**

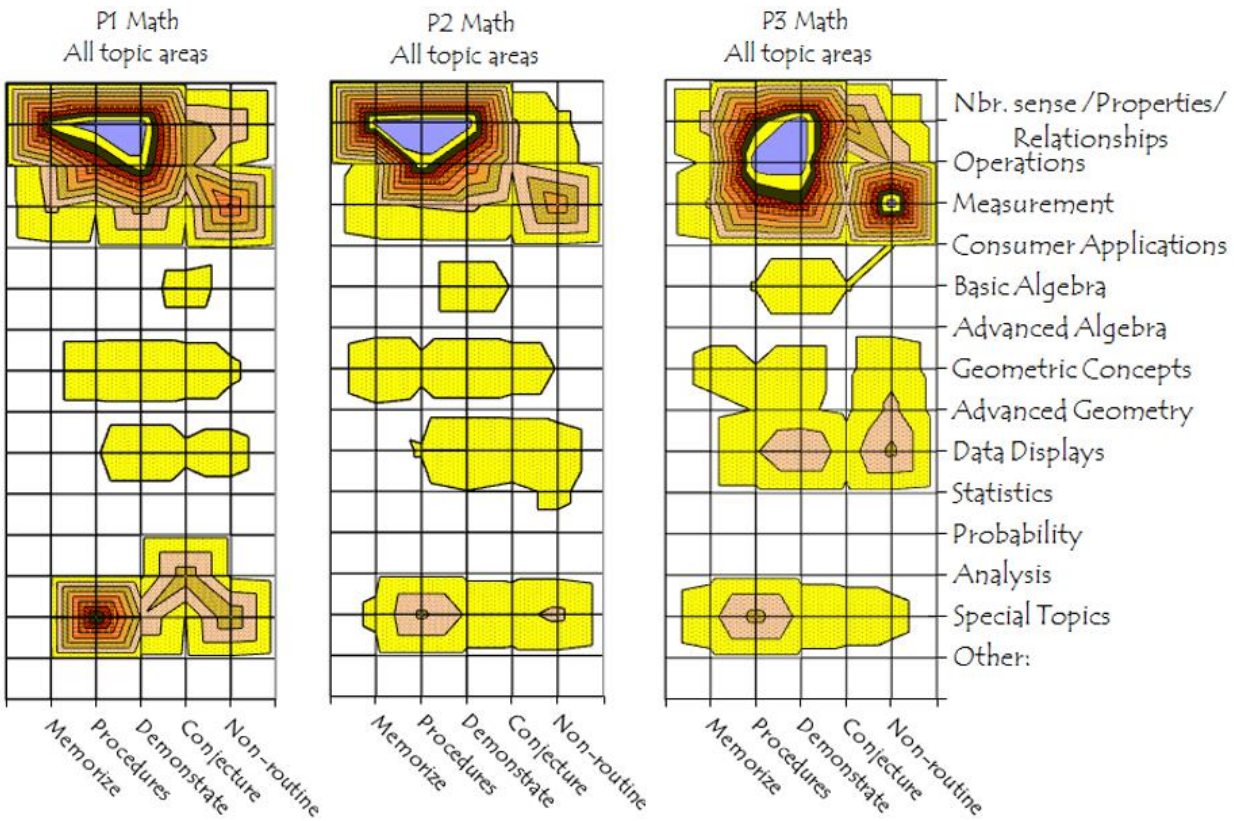


Figure 1 (a): Course grain maps – Mathematics P1-P3

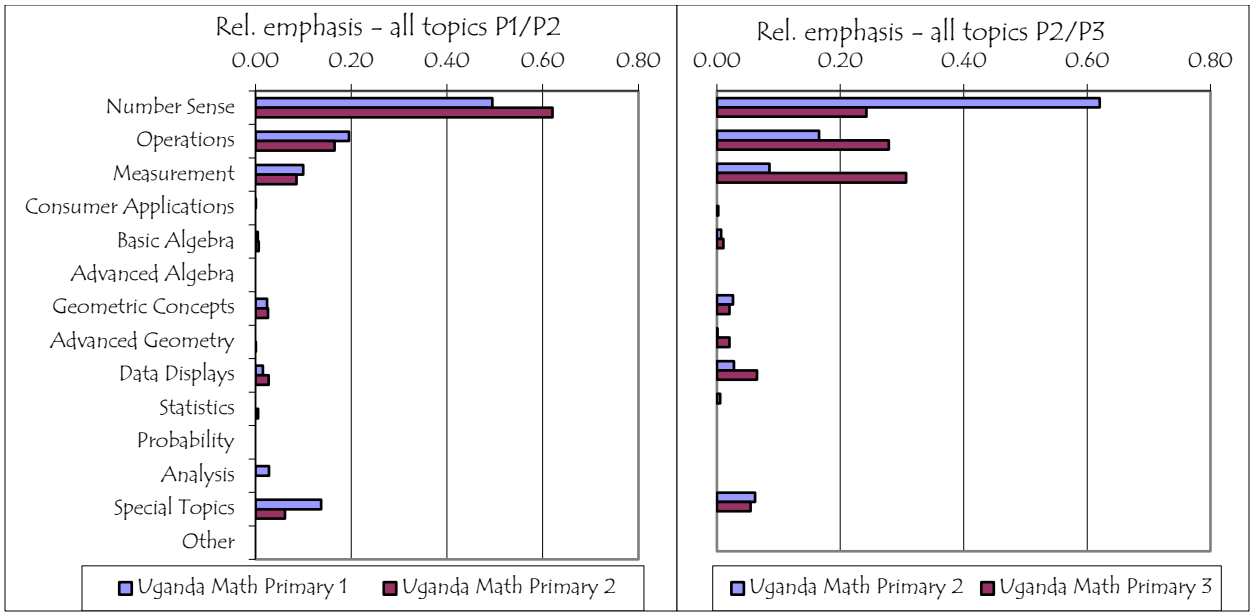


Figure 1(b): Relative emphasis on topics P1/P2 and P2/P3

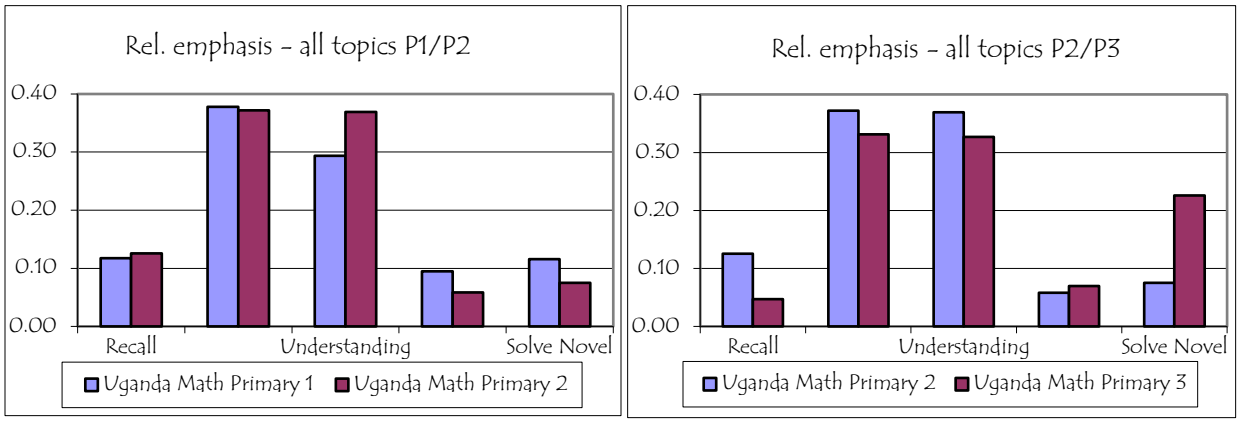


Figure 1(c): Relative emphasis on cognitive demand P1/P2 and P2/P3

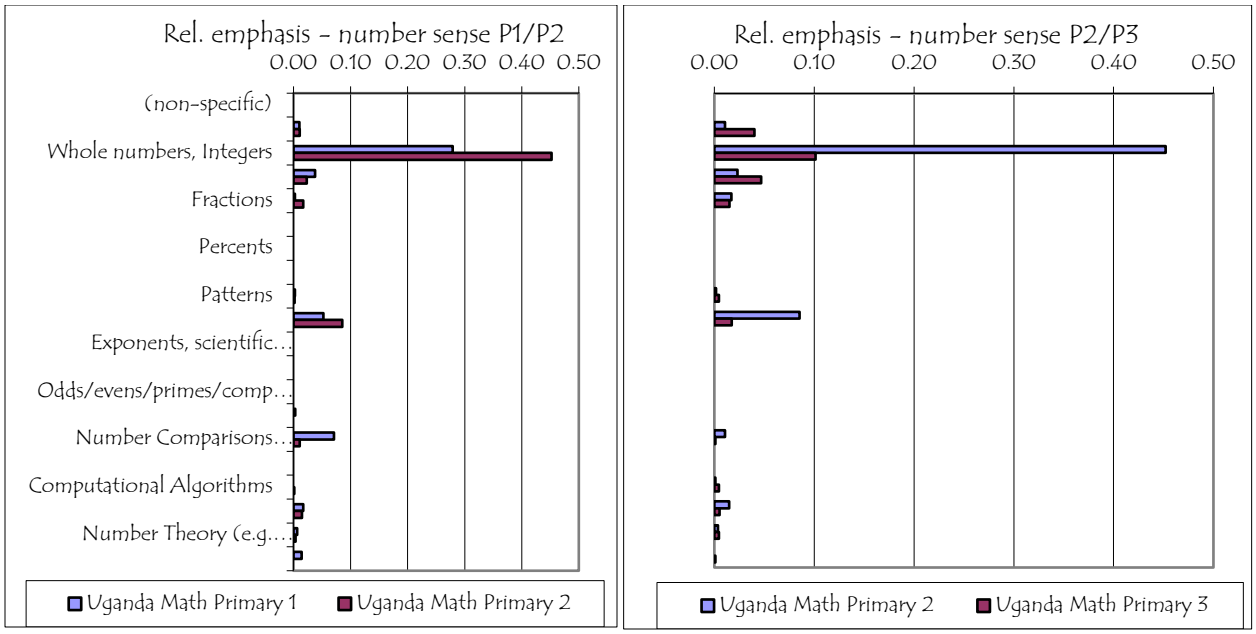


Figure 2(a): Relative emphasis on subtopics – number sense P1/P2 and P2/P3

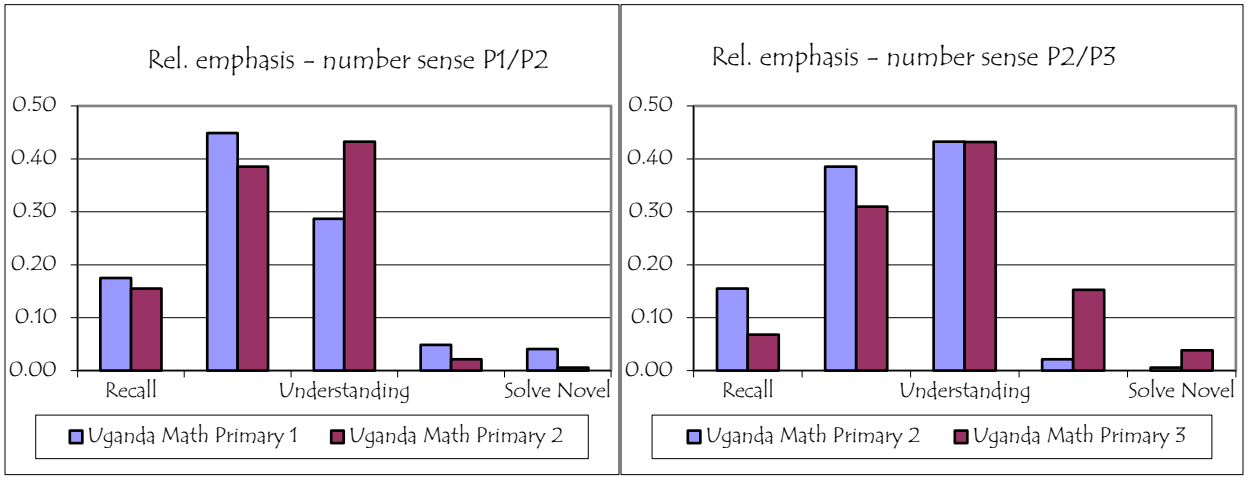


Figure 2(b): Relative emphasis on cognitive demand – number sense P1/P2 and P2/P3

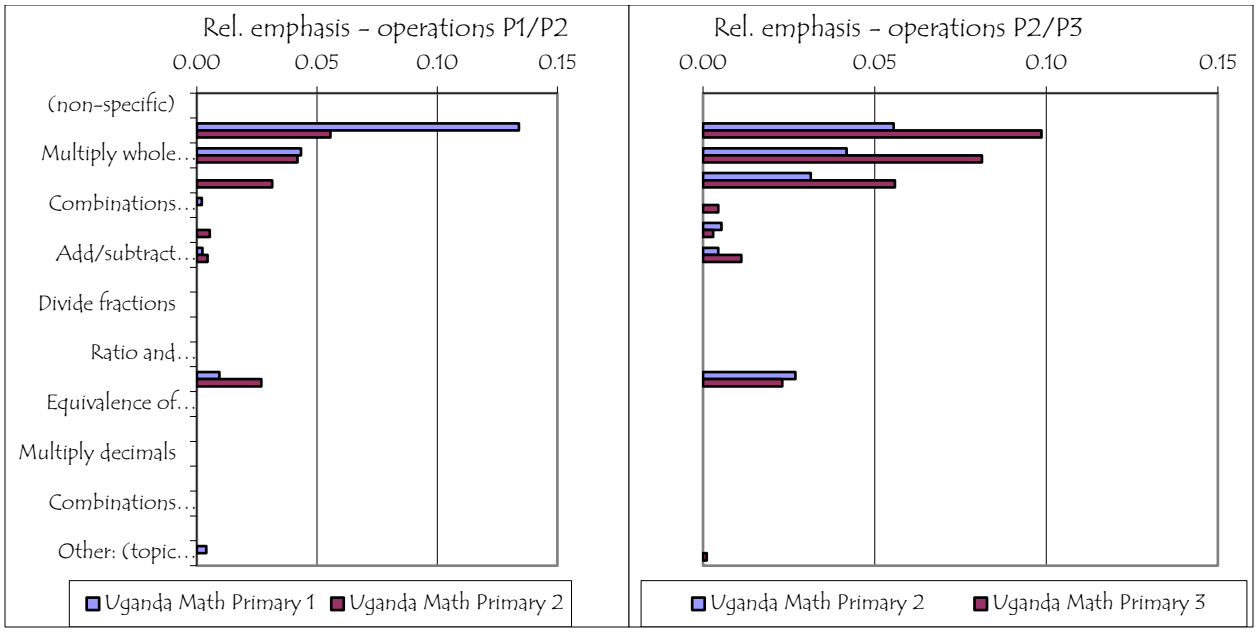


Figure 3(a): Relative emphasis on subtopics – operations P1/P2 and P2/P3

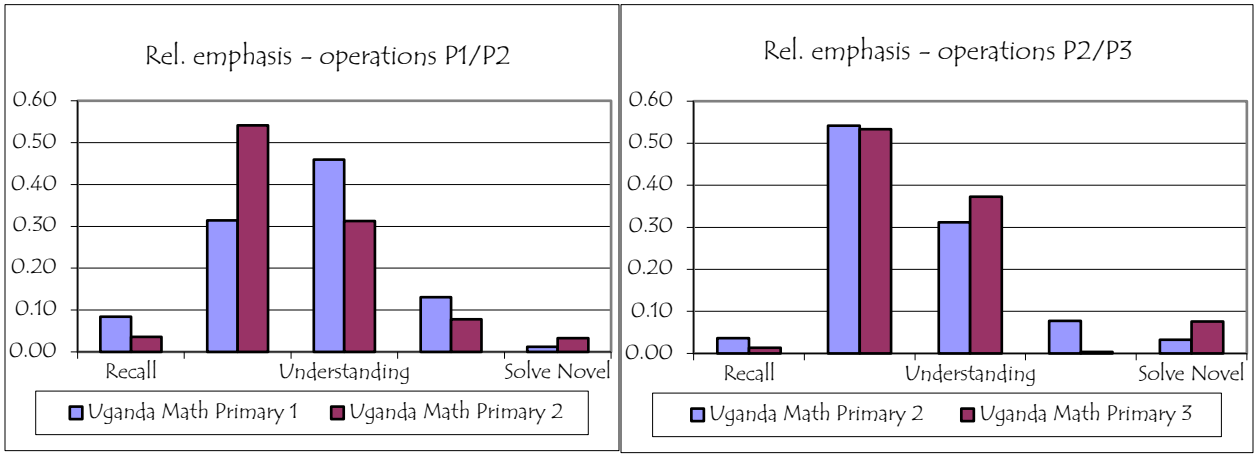


Figure 3(b): Relative emphasis on cognitive demand – operations P1/P2 and P2/P3

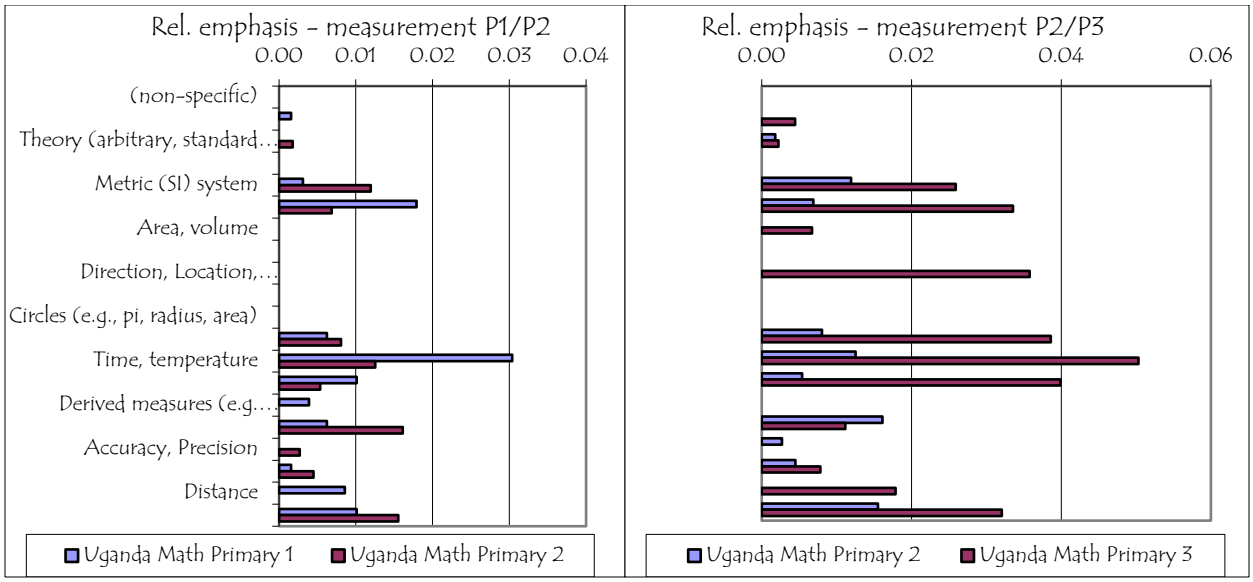


Figure 4(a): Relative emphasis on subtopics – measurement P1/P2 and P2/P3

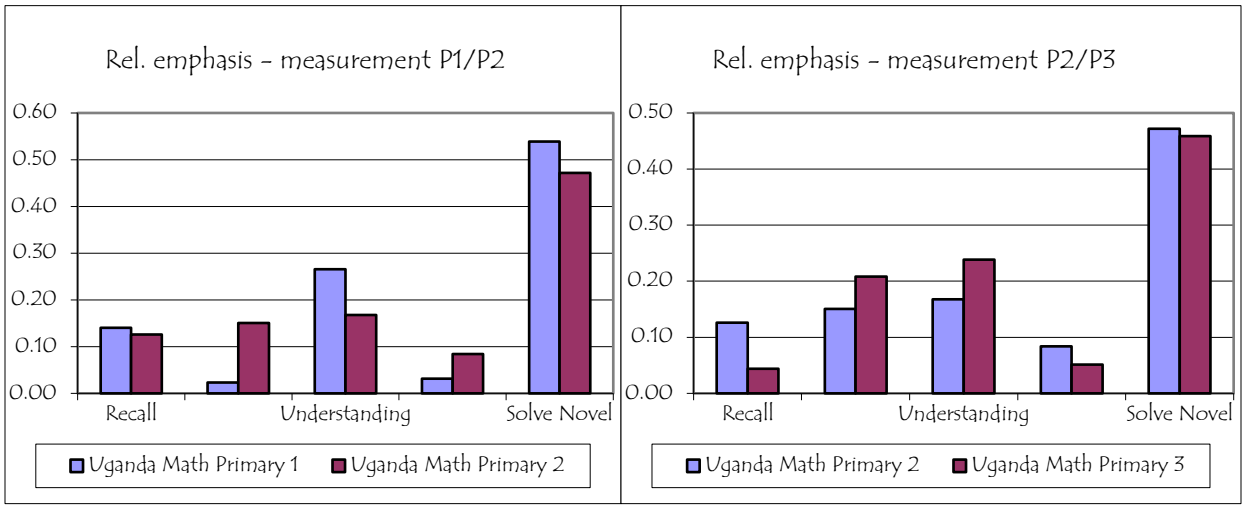


Figure 4(b): Relative emphasis on cognitive demand – measurement P1/P2 and P2/P3

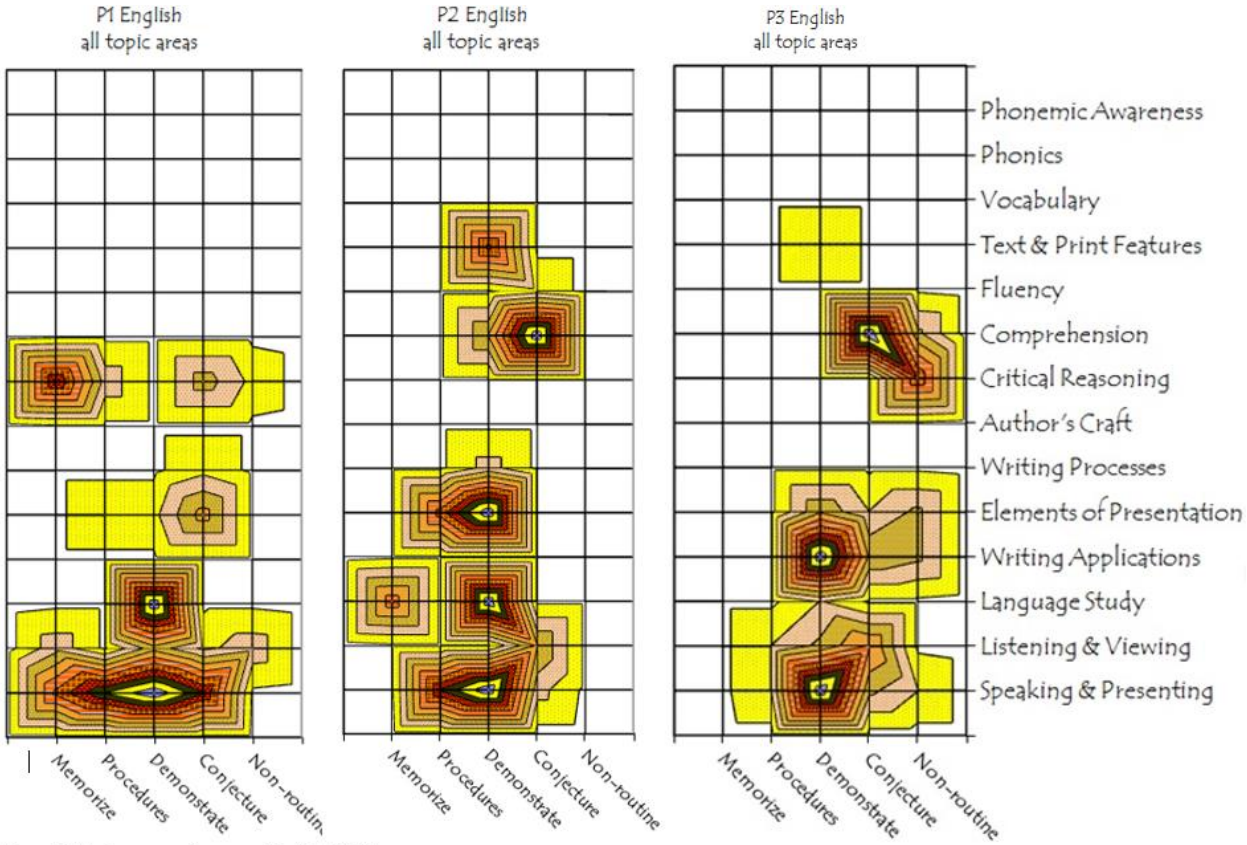


Figure 5 (a): Course grain maps – English P1-P3

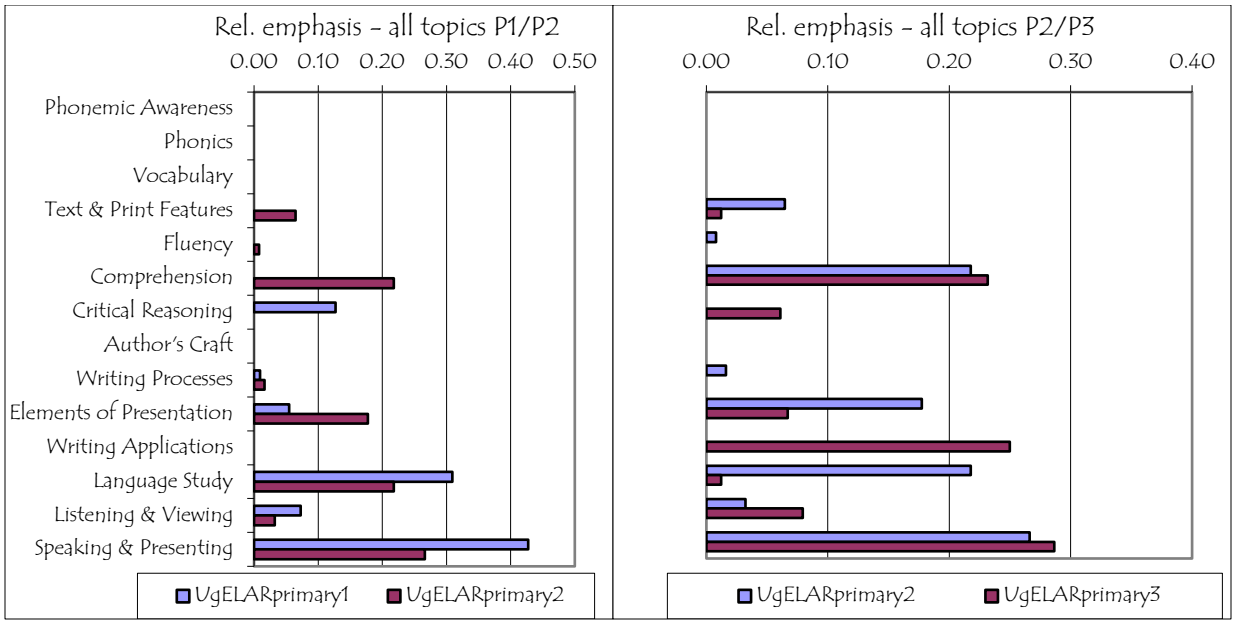


Figure 5(b): Relative emphasis on topics P1/P2 and P2/P3

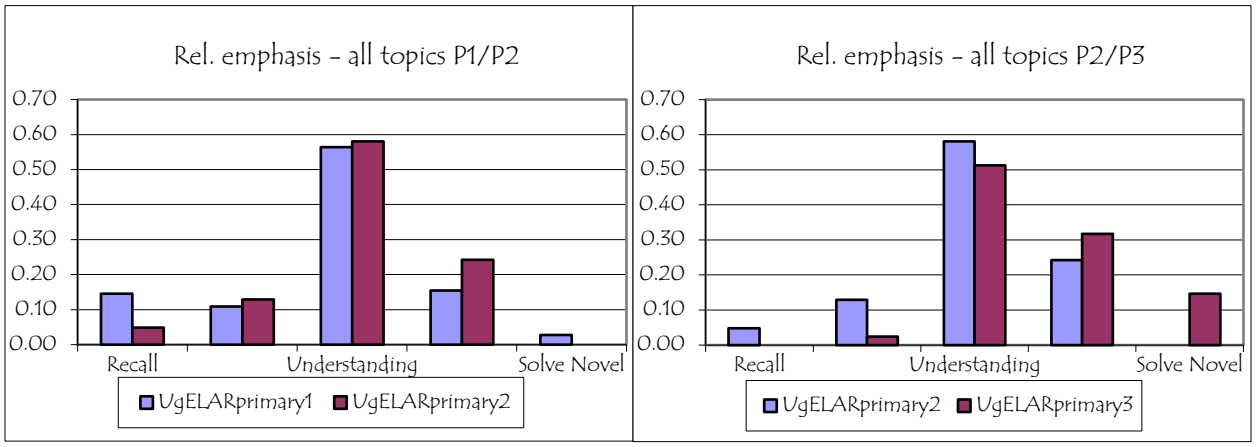


Figure 5(c): Relative emphasis on cognitive demand P1/P2 and P2/P3

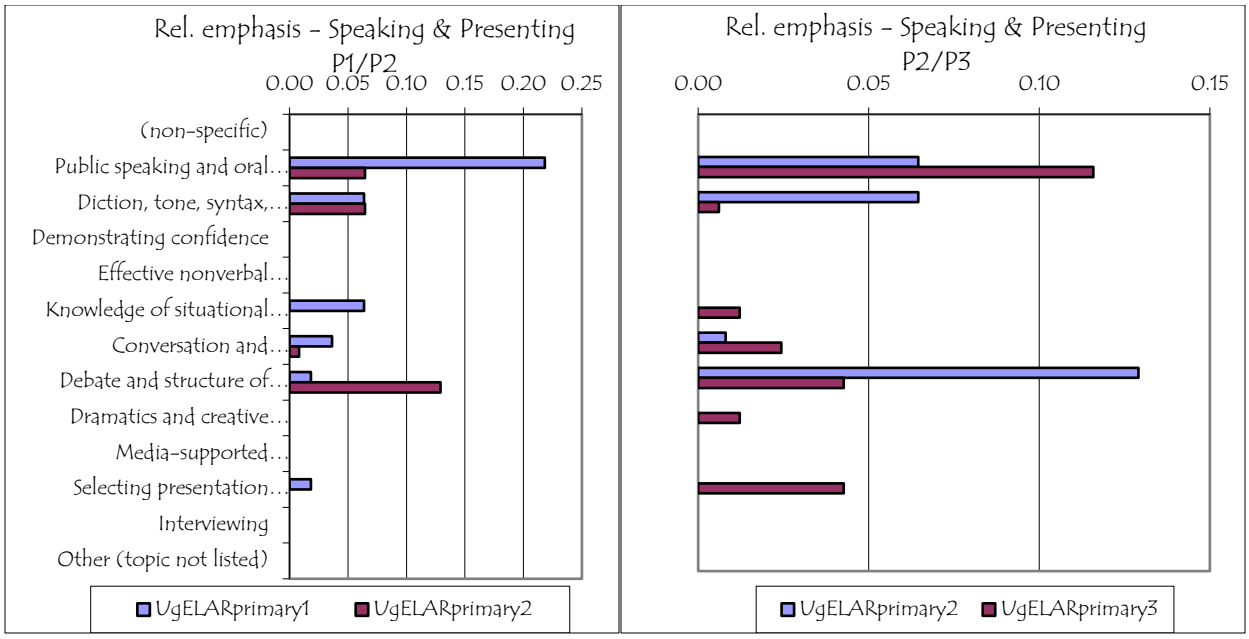


Figure 6(a): Relative emphasis on topics P1/P2 and P2/P3

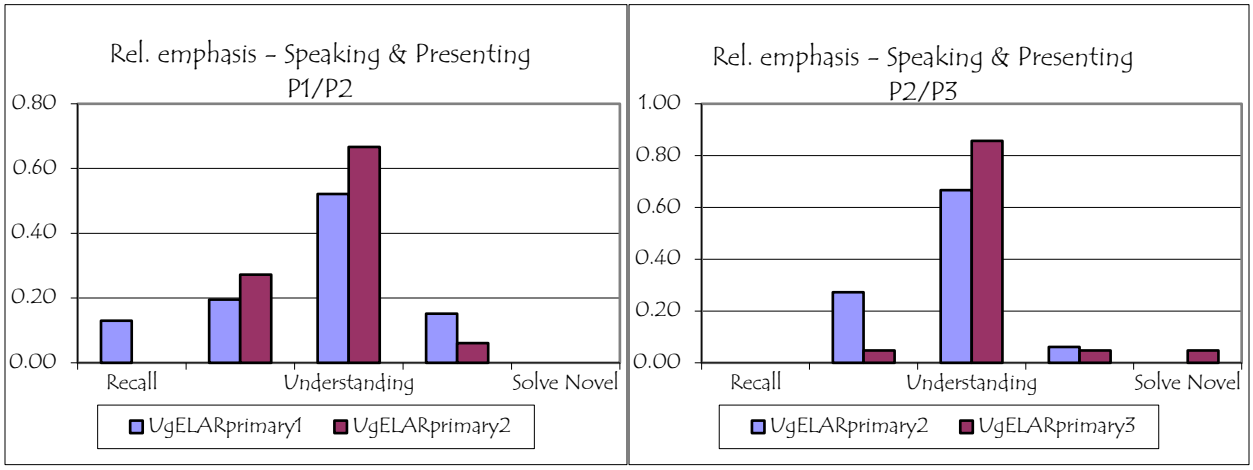


Figure 6(b): Relative emphasis on cognitive demand P1/P2 and P2/P3

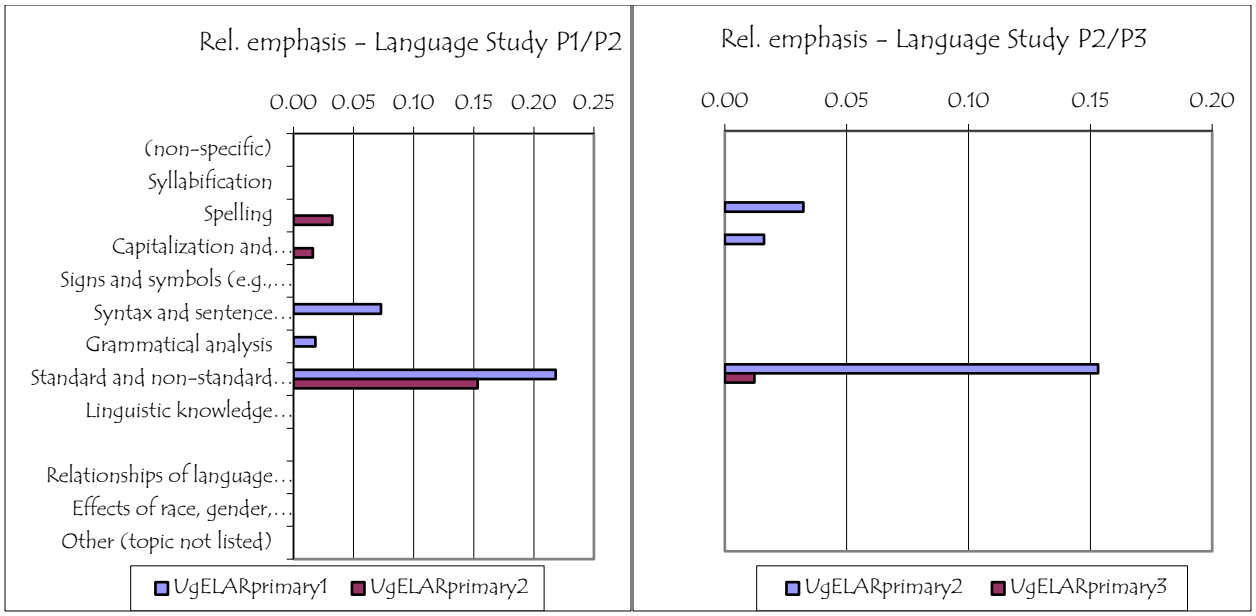


Figure 7(a): Relative emphasis on topics P1/P2 and P2/P3

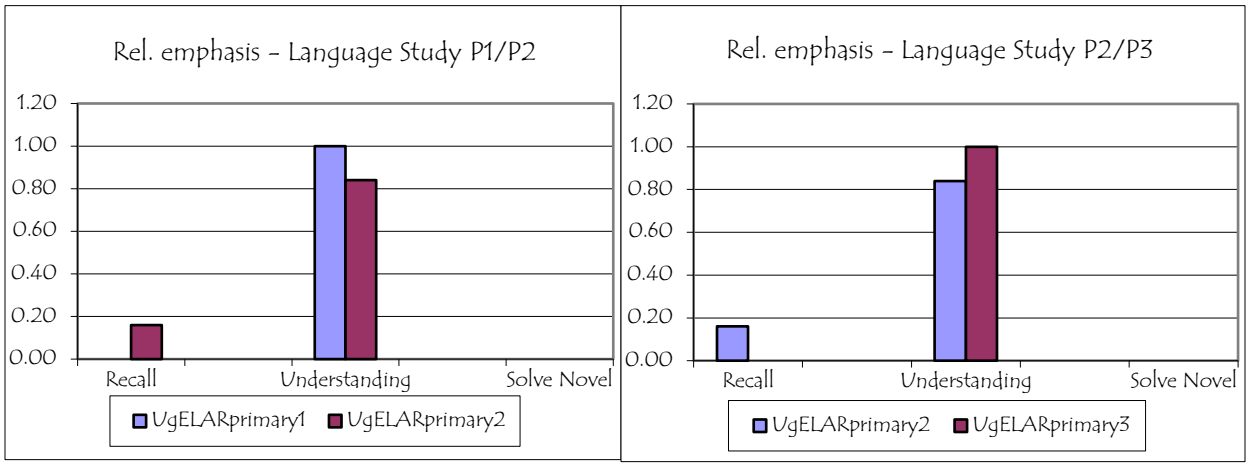


Figure 7(b): Relative emphasis on cognitive demand P1/P2 and P2/P3

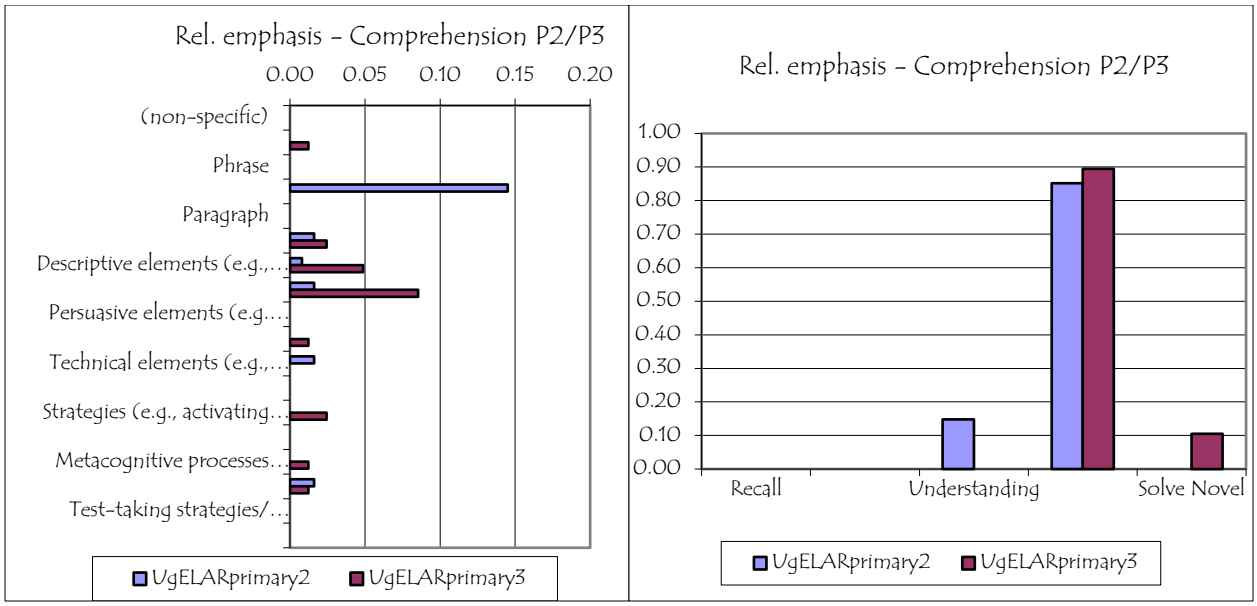
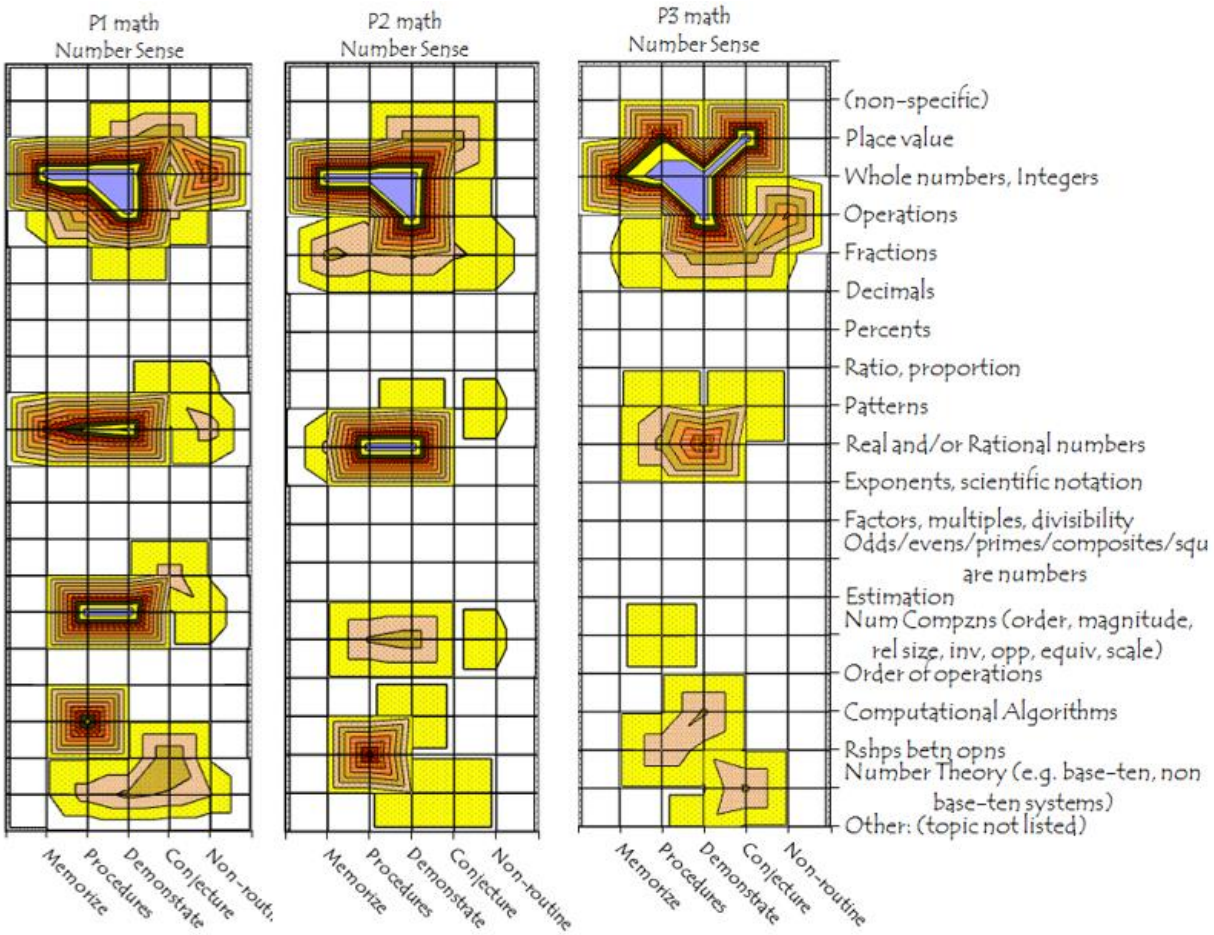
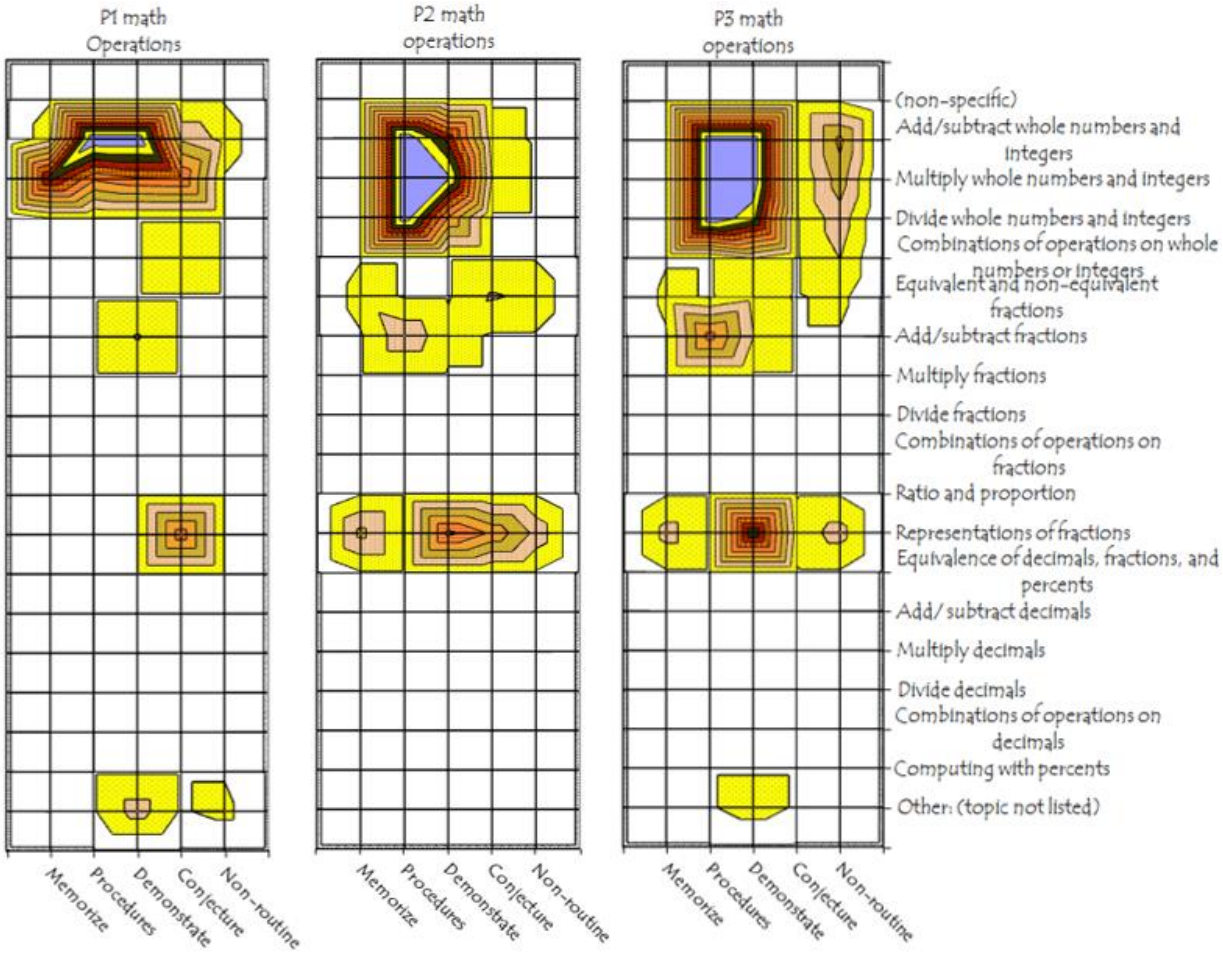


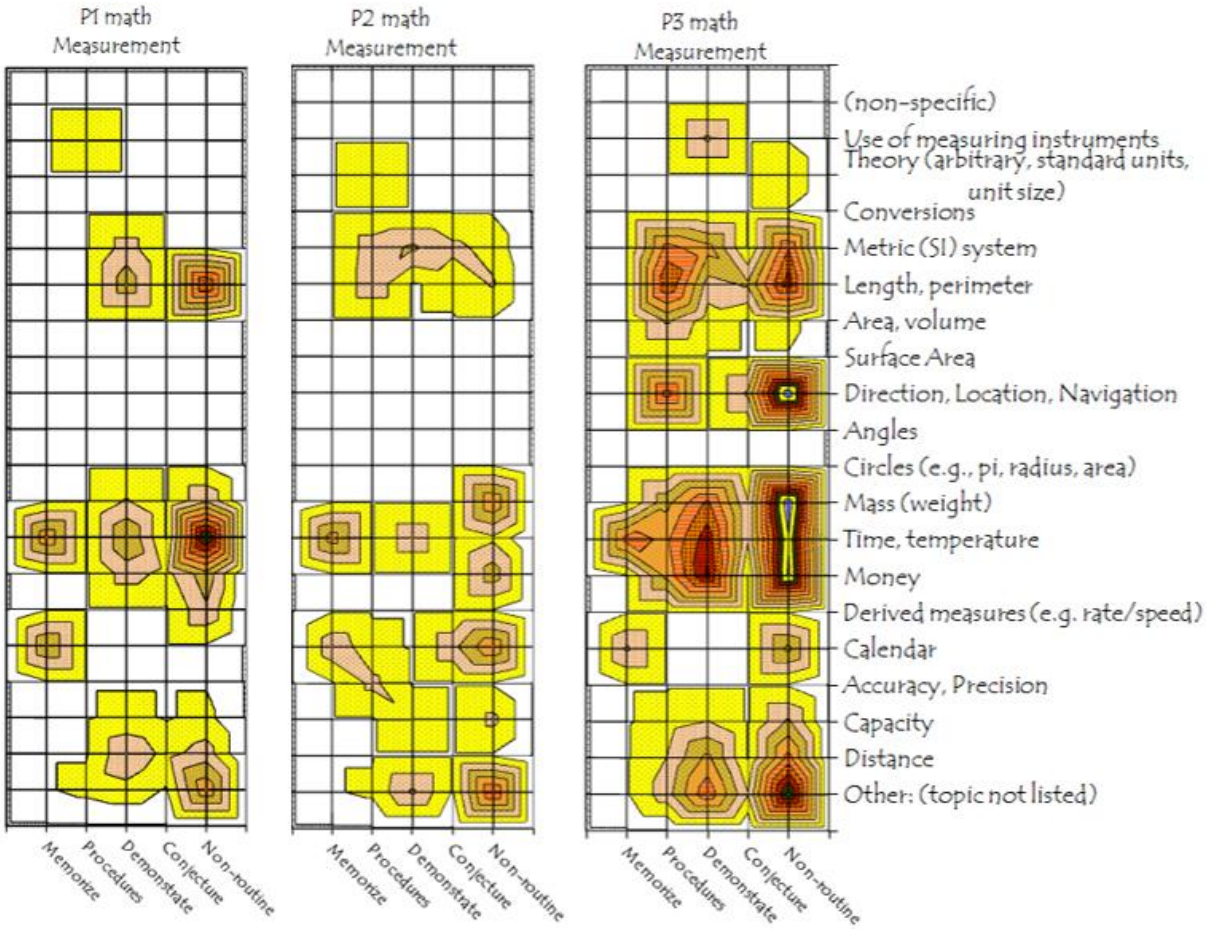
Figure 8: Relative emphasis - comprehension P2/P3



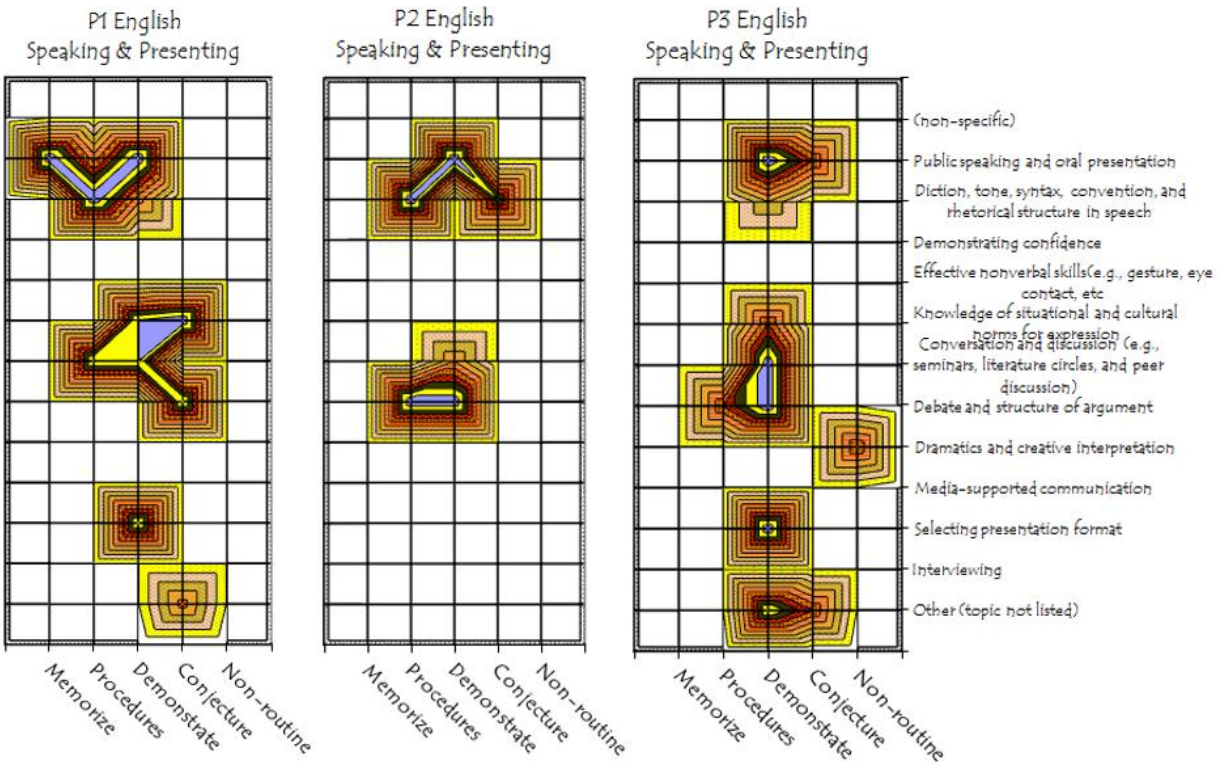
Appendix A: Fine grain maps – Number sense P1-P3



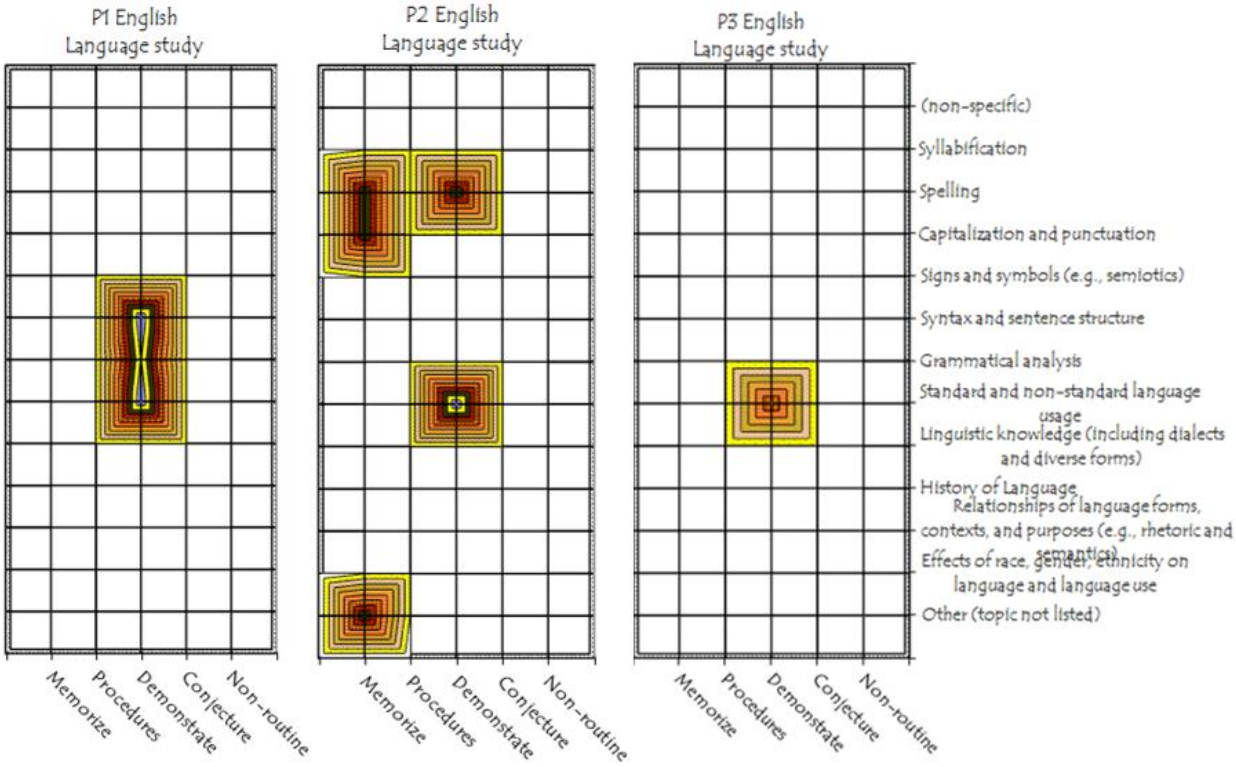
Appendix B: Fine grain maps – Operations P1-P3



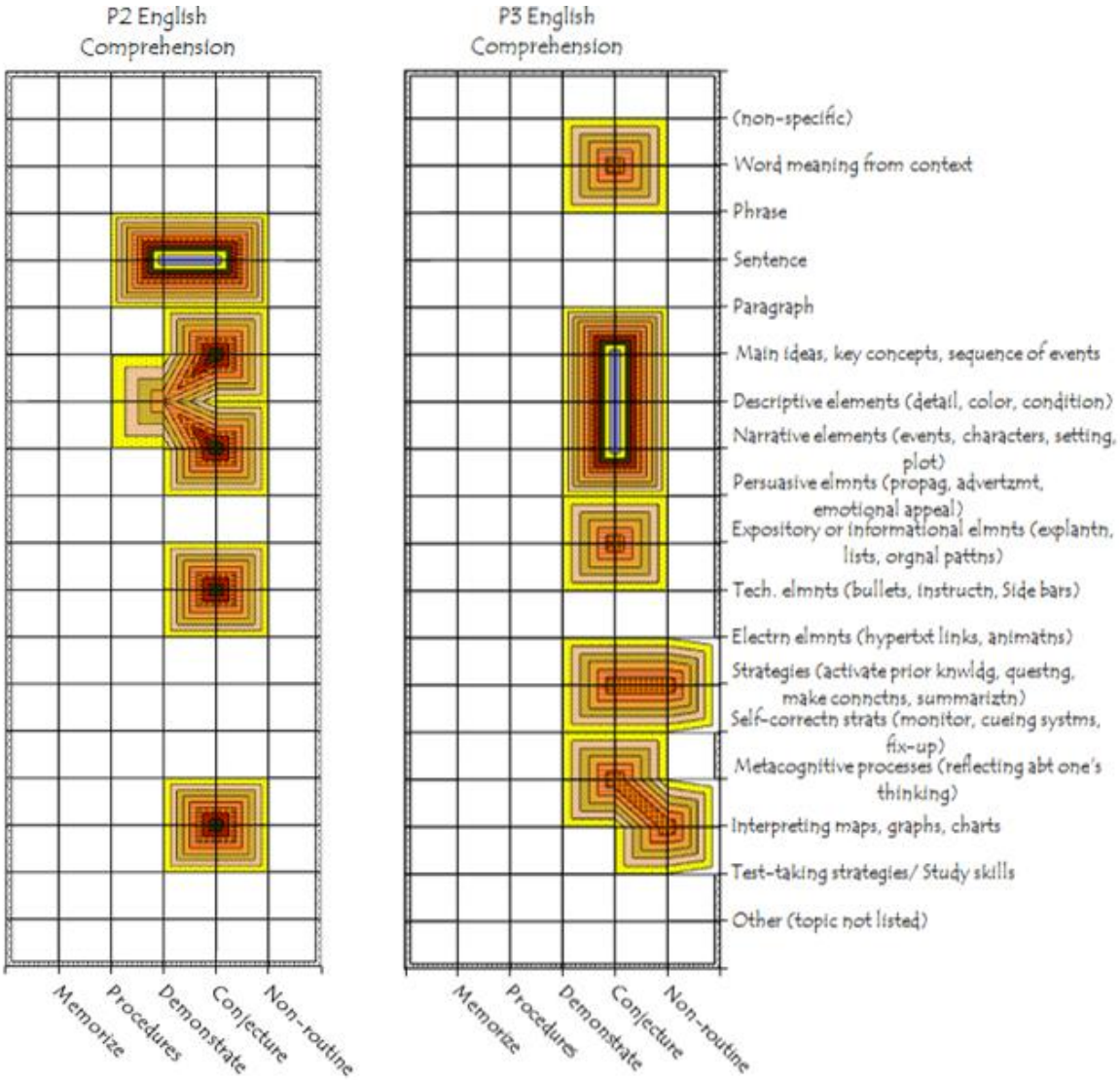
Appendix C: Fine grain maps – Measurement P1-P3



Appendix D: Fine grain maps – Speaking & Presenting P1-P3



Appendix E: Fine grain maps – Language study P1-P3



Appendix F: Fine grain maps – Comprehension P2-P3

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Annex A1: Cognitive demand matrix for Mathematics

Cognitive Demand Categories for Mathematics

B	C	D	E	F
Memorize Facts, Definitions, Formulas	**Perform Procedures**	**Demonstrate Understanding of Mathematical Ideas**	**Conjecture, Analyze, Generalize, Prove**	**Solve Non-Routine Problems / Make Connections**
Recite basic mathematical facts	Use numbers to count, order, denote	Communicate mathematical ideas	Determine the truth of a mathematical pattern or proposition	Apply and adapt a variety of appropriate strategies to solve non-routine problems
Recall mathematics terms and definitions	Do computational procedures or algorithms	Use representations to model mathematical ideas	Write formal or informal proofs	Apply mathematics in contexts outside of mathematics
Recall formulas and computational procedures	Follow procedures / instructions	Explain findings and results from data analysis strategies	Recognize, generate or create patterns	Apply to real world situations
	Solve equations/formulas/ routine word problems	Develop/explain relationships between concepts	Find a mathematical rule to generate a pattern or number sequence	Synthesize content and ideas from several sources
	Organize or display data	Show or explain relationships between models, diagrams, and/or other representations	Make and investigate mathematical conjectures	
	Read or produce graphs and tables		Identify faulty arguments or misrepresentations of data	
	Execute geometric constructions		Reason inductively or deductively	

Annex B1: Cognitive demand matrix for English

Cognitive Demand Categories for English / Language Arts / Reading

B	C	D	E	F
Memorize / Recall	**Perform Procedures / Explain**	**Generate / Create / Demonstrate**	**Analyze / Investigate**	**Evaluate/Integrate**
Reproduce sounds or words	Follow instructions	Create / develop connections among text, self, world	Categorize / schematize information	Determine relevance, coherence, internal consistency, logic
Provide facts, terms, definitions, conventions	Give examples	Recognize relationships	Distinguish fact and opinion	Assess adequacy, appropriateness, credibility
Locate literal answers in text	Check consistency	Dramatize	Compare and contrast	Test conclusions, hypotheses
Identify relevant information	Summarize	Order, group, outline, organize ideas	Identify with another's point of view	Synthesize content and ideas from several sources
Describe	Identify purpose, main ideas, organizational patterns	Express new ideas (or express ideas newly)	Make inferences, draw conclusions	Integrate with other topics and subjects
	Gather information	Develop reasonable alternatives	Predict probable consequences	Critique
			Generalize	

Annex A2: Contextualized Taxonomy for Primary Mathematics – Uganda

Mathematics Taxonomy - Uganda

100	**Nbr. sense /Properties/ Relationships**
101	Place value
102	Whole numbers and Integers
103	Operations
104	Fractions
105	Decimals
106	Percents
107	Ratio and proportion
108	Patterns
109	Real and/or Rational numbers
110	Exponents and scientific notation
111	Factors, multiples, and divisibility
112	Odd/even/prime/composite/square numbers
113	Estimation
114	Number Comparisons (order, magnitude, relative size, inverse, opposites, equivalent forms, scale or number line)
115	Order of operations
116	Relationships between operations
117	Number Theory (e.g. base-ten and non-base-ten systems)
118	Mathematical properties (e.g., distributive property)
190	Other
200	**Operations**
201	Add/subtract whole numbers and integers
202	Multiply whole numbers and integers
203	Divide whole numbers and integers
204	Combinations of operations on whole numbers or integers
205	Equivalent and non-equivalent fractions
206	Add/subtract fractions
207	Multiply fractions
208	Divide fractions
209	Combinations of operations on fractions
210	Ratio and proportion
211	Representations of fractions
212	Equivalence of decimals, fractions, and percents
213	Add/ subtract decimals
214	Multiply decimals
215	Divide decimals
216	Combinations of operations on decimals
217	Computing with percents
290	Other

300	**Measurement**
301	Use of measuring instruments
302	Theory (arbitrary, standard units and unit size)
303	Conversions
304	Metric (SI) system
305	Length and perimeter
306	Area and volume
307	Surface Area
308	Direction, Location
309	Angles
310	Circles (e.g., pi, radius, area)
311	Mass (weight)
312	Time and temperature
313	Money
314	Derived measures (e.g., rate and speed)
315	Calendar
316	Accuracy and precision
317	Capacity
318	Distance
390	Other
400	**Consumer Applications**
401	Simple interest
402	Rates (e.g., discount and commission)
490	Other
500	**Basic Algebra**
501	Absolute value
502	Use of variables
503	Evaluation of formulas, expressions, and equations
504	One-step equations
505	Coordinate Planes
506	Patterns
507	Multi-step equations
508	Inequalities
509	Linear and non-linear relations
510	Rate of change/slope/line
511	Operations on polynomials
512	Factoring
513	Square roots
590	Other

600	**Advanced Algebra**
601	Rules for exponents
690	Other
700	**Geometric Concepts**
701	Basic terminology
702	Points, lines, rays, segments, and vectors
703	Patterns
704	Similarity
705	Parallels
706	Triangles
707	Quadrilaterals
708	Circles
709	Angles
710	Polygons
711	3-D relationships
712	Symmetry
713	Transformations (e.g., flips or turns)
714	Pythagorean Theorem
790	Other
800	**Advanced Geometry**
801	Spheres, cones, and cylinders
802	Coordinate Geometry
890	Other

900	**Data Displays**
901	Summarize data in a table or graph
902	Bar graph and histograms
903	Pie charts and circle graphs
904	Pictographs
905	Line graphs
906	Venn diagrams
990	Other
1000	**Statistics**
1001	Mean, median, and mode
1002	range
1090	Other
1100	**Probability**
1101	Simple probability
1190	Other
1200	**Analysis**
1201	Sequences and series
1290	Other
1300	**Special Topics**
1301	Sets
1390	Other

Annex B2: Contextualized Taxonomy for Primary English – Uganda

English Language Taxonomy

100	**Phonemic awareness**
101	Phoneme isolation(e.g. the distinct sounds /c/,/a/,and /t/
102	Phoneme blending (e.g., c/a/t = cat)
103	Phoneme segmentation
104	Onset-rime
105	Sound patterns
106	Rhyme recognition
107	Phoneme deletion, substitution, and addition
108	Identify Syllables
190	Other
200	**Phonics**
201	Alphabetic principle (includes alphabet recognition and order)
202	Consonants
203	Consonant blends
204	Consonant digraphs (e.g., ch, sh, th, etc.)
205	Diphthongs (e.g., oi, ou, ow, oy [as in "boy"], etc.)
206	R-controlled vowels (e.g., farm, torn, turn, etc.)
207	Patterns within words
208	Vowel letters (a, e, i, o, u, y)
209	Vowel phonemes (15 sounds)
210	Sound and symbol relationships
211	Blending sounds
290	Other
300	**Vocabulary**
301	Compound words and contractions
302	Inflectional forms (e.g., -s, -ed, -ing)
303	Suffixes, prefixes, and root words
304	Word definitions (including new vocabulary)
305	Word origins
306	Synonyms, antonyms, homonyms
307	Word or phrase meaning from context
308	Denotation and connotation
309	Analogies
310	Sight words
311	Use of references
390	Other

400	**Text and print features**
401	Book handling
402	Directionality; sequence of text
403	Parts of a book (e.g., cover, title, front, back)
404	Letter, word, and sentence distinctions
405	Structural elements (e.g., index, glossary, table of contents, subtitles, and headings)
406	Graphical elements (e.g., graphs, charts, images, illustrations)
407	Technical elements (e.g., bullets, instructions, forms, sidebars)
408	Electronic elements (e.g., hypertext links, animations)
409	Environmental print, i.e. prints or symbols found in students' everyday environment
490	Other

500	**Fluency**
501	Prosody (e.g., phrasing, intonation, and inflection)
502	Automaticity of words and phrases (e.g. sight and decodable words)
503	Speed and pace
504	Accuracy
505	Independent reading (e.g. repeated/silent reading for fluency)
590	Other
600	**Comprehension**
601	Word meaning from context
602	Phrase
603	Sentence
604	Paragraph
605	Main idea(s), key concepts, and sequence(s) of events
606	Descriptive elements (e.g., detail, color, condition)
607	Narrative elements (e.g., events, characters, setting, and plot)
608	Persuasive elements (e.g. propaganda, advertisement, and emotional appeal)
609	Expository or informational elements (e.g., explanation, lists, and organizational patterns such as description, cause-effect, and compare-contrast)
610	Technical elements (e.g., bullets, instruction, form, Side bars, etc.)
611	Electronic elements (e.g., hypertext links, animations)
612	Strategies (e.g., activating prior knowledge, questioning; making connections, predictions; inference, imagery, summarization, re-telling)
613	Self-correction strategies (e.g., monitoring, cueing systems, and fix-up)
614	Metacognitive processes (e.g., reflecting about one's thinking)
615	Interpreting maps, graphs, charts
616	Test-taking strategies/ Study skills
690	Other

700	**Critical Reasoning**
701	Fact and opinion
702	Appealing to authority, reason, or emotion
703	Validity and significance of assertion or argument
704	Relationships among purpose, organization, format, and meaning in text
705	Author's assumptions or bias
706	Comparison of topic, theme, treatment, scope, or organization across texts
707	Inductive/deductive approaches (e.g., making inferences and drawing conclusions from texts)
708	Logical reasoning in text (e.g. implications, authors' rationale, development of argument, etc.)
709	Textual evidence and/or use of references to support
710	Drawing meaning from allegory and myth
711	Distinguishing real from fantastical events in literature
790	Other

800	**Author's craft**
801	Theme/thesis
802	Purpose (e.g., inform, perform, critique, or appreciate)
803	Characteristics of genre and forms
804	Point of view (e.g., first or third person, multiple perspectives, etc.)
805	Literary devices (e.g., analogy, simile, metaphor, hyperbole, flashbacks, structure, and archetypes)
806	Literary analysis (e.g., symbolism, voice, style, tone, and mood)
807	Influence of time and place on authors and texts (e.g., historical era or culture)
808	Aesthetic aspects of text (e.g. dramatic or poetic elements)
890	Other
900	**Writing processes**
901	Printing, cursive writing, and penmanship
902	Pre-writing (e.g., essential questions, topic selection, Brain storming, etc.)
903	Drafting and revising
904	Editing for conventions (e.g., usage, spelling, and structure)
905	Manuscript conventions (e.g., indenting, margins, citations, references, etc.)
906	Final draft and publishing
907	Use of technology (e.g., word processing, multimedia, etc.
990	Other

1000	**Elements of Presentation (Verbal and Written)**
1001	Purpose, audience, and context 2 of 3
1002	Main ideas
1003	Organization
1004	Word choice
1005	Support and elaboration
1006	Style, voice, technique, and use of figurative language
1007	Writing Conventions (e.g. capitalization, punctuation, indentation, citation, etc.)
1008	Transitional Devices
1090	Other
1100	**Writing applications**
1101	Narrative (e.g., stories, fiction, and plays)
1102	Poetry
1103	Expository (e.g., report, theme, essay, etc.)
1104	Critical/evaluative (e.g., review)
1105	Expressive (e.g., journals or reflections)
1106	Persuasive (e.g., editorial, advertisement, argumentative)
1107	Procedural (e.g., instructions, brochure, lab report)
1108	Technical(e.g., manuals, specifications, research
1109	Real world applications of writing (e.g., resumes, letters to editor, note taking)
1190	Other

1200	**Language Study**
1201	Syllabification
1202	Spelling
1203	Capitalization and punctuation
1204	Signs and symbols (e.g., semiotics)
1205	Syntax and sentence structure
1206	Grammatical analysis
1207	Standard and non-standard language usage
1208	Linguistic knowledge (including dialects and diverse forms)
1210	Relationships of language forms, contexts, and purposes (e.g., rhetoric and semantics)
1211	Effects of race, gender, ethnicity on language and language use
1290	Other
1300	**Listening and Viewing**
1301	Listening
1302	Viewing
1303	Nonverbal communication
1304	Consideration of others' ideas
1305	Similarities/differences of print, graphic, and nonprint communications
1306	Literal and connotative meanings
1307	Diction, tone, syntax, convention, rhetorical structure in speech
1308	Media-supported communication
1390	Other

1400	**Speaking and Presenting**
1401	Public speaking and oral presentation
1402	Diction, tone, syntax, convention, and rhetorical structure in speech
1403	Demonstrating confidence
1404	Effective nonverbal skills(e.g., gesture, eye contact, etc
1405	Knowledge of situational and cultural norms for expression
1406	Conversation and discussion (e.g., seminars, literature circles, and peer discussion)
1407	Debate and structure of argument
1408	Dramatics and creative interpretation
1409	Media-supported communication
1410	Selecting presentation format
1411	Interviewing
1490	Other
1500	**Forms of Text**
1501	Myths, tales, fables, or epics
1502	Short stories
1503	Novels (including chapter books)
1504	Picture books
1505	Drama
1506	Poetry
1507	Public documents
1508	Consumer, technical, and business writing (e.g., manuals, how-to texts, ads, memos)
1509	Newspaper or magazine articles
1510	Speeches
1511	Essays
1512	Criticism and commentary
1513	Historical accounts
1514	Biography and autobiography
1515	Content area materials
1590	Other