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Grade 7 mathematics textbooks' differentiation in the Philippines: Illusion or reality?

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Abstract

Educators are challenged to adjust curriculum materials to support the access of each student to high-quality learning. Curriculum differentiation entails designing learning content and opportunities for all types of learners. In the Philippines, the Basic Education textbook is the main resource in delivering core subjects such as mathematics. This study contributes understanding about and practical implementation of curriculum differentiation utilising Qualitative Content Analysis using apriori codes to describe differentiation in six Grade 7 mathematics textbooks. Findings show that the textbooks analysed in the study provide the same types of differentiation but differ in extent. The most common differentiations are using real life situations, abstractions, and proof of reasoning. This paper argues that while Grade 7 mathematics textbooks in the Philippines apply Maker's principles of differentiation in introducing and presenting lessons, learning exercises, and in the mastery test, they have yet to be adjusted according to students' interest and learning profiles.

Keywords: Curriculum differentiation, Philippine mathematics textbooks' analysis, content analysis of textbooks.

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1. Introduction

1.1. Curriculum differentiation

Given the general agreement, that one size does not fit all in addressing the diverse learning needs of the students (Roofe, 2014), teachers are often expected to adjust curriculum materials and support to ensure that each student has equity of access to high-quality learning (Tomlinson, Brighton, Hertberg, Callahan, Moon, Brimijoin, Conover & Reynolds, 2003). Adjusting curriculum means curriculum differentiation, it entails designing learning opportunities for students who differ in their readiness levels, their interests, and their learning profiles (Tomlinson, 1999, as cited in Landrum & McDuffie, 2010). It is noted that providing an enriched curriculum to top students helps them improve their potential (McCoach, Gubbins, Foreman, Rubenstein & Rambo-Hernandez, 2014). In relation to this, Tornroos (2005) considers that the implemented curriculum encompasses textbooks and other written instructional materials used in class which contribute in shaping the instruction given in the classrooms.

Textbook analysis is a popular field of research (Cobanoglu, Sahin & Karakaya, 2009) that qualifies and quantifies the differences of their occurrences and investigates the presence, connection, and relationship of concepts in the textbook (Abdulai & Owusu-Ansah, 2014, as cited in Palmquist et al, 1997); and organizes information using a categorical system (Moyer-Packenham, Bolyard, Oh, Kridler & Salkind, 2006). In the Philippines, the timing of textbooks analysis is valuable because the Department of Education (DepEd) just adopt the K to 12 curriculum program which the content of this curriculum is delivered through textbooks and this is applied to all subject areas including mathematics (DepEd, 2016).

1.2. Two approaches to curriculum differentiation

Tomlinson (Tomlinson et al, 2002, as cited in Gavin, Casa, Adelson & Sheffield, 2009) and Maker's (Maker & Schiever, 2010) principles of curriculum modification draw on different notions of curriculum differentiation while overlapping in some areas such as the focus on key concepts, principles, and skills essential to the discipline, which are coherent and organized to achieve the intended outcomes.

Tomlinson's notion of differentiation provides more details on differentiation according to students' readiness, interest, and profile (Tomlinson, 2005). According to Tomlinson and Eidson (2003, cited by Brandstrom, 2005), appropriating lessons and tasks with respect to students' knowledge, understanding and skills is beneficial to all students.

Another prevalent differentiation approach to curriculum differentiation is the Maker Model of differentiation. Maker and his co-authors (1982 as cited in Maker & Schiever, 2010) provide guiding principles for the modification of learning content, process, product, and learning environment. Maker proposes principles for curriculum modification. These address diverse learners' needs, wherein teachers can select and apply one or more of these principles. The Maker Model has been used as an effective guide in planning a differentiated curriculum (Tomlinson et al, 2003); analysing the content (Tassel-Baska, 2008); and determining the efficacy of a differentiated curricula and instruction (Kanevsky, 2011). Hence, this Model of curriculum differentiation is used as a *apriori* for this study.

1.3. Curriculum differentiation in mathematics textbooks

In mathematics, differentiation both in instruction and in curriculum has been found to be effective (Tomlinson et al, 2003) in catering to the individuality of students (Brimijoin, 2005); helping students to have positive attitudes; improve their achievement (Beecher & Sweeny, 2008); support students' learning in mathematics (Chamberlin & Powersz, 2010); and makes students engaged (Anderson, 2007) when students' interests and choices are considered. (Beecher & Sweeny, 2008, as cited in Reis, & Renzulli, 2011).

In mathematics textbooks, differentiation is more on structuring the content into smaller units or arranging the lesson according to pre-requisites (Brändström, 2005). This type of differentiation is based on students' demonstrated prior knowledge (readiness) (Tomlinson, 2001, Tomlinson & Jarvis, 2009, cited by Brändström, 2005) or tiered activities (Rubenstein, Gilson, Bruce-Davis & Gubbins, 2015; Tomlinson, 2001, as cited in Brändström, 2005), in which students can work at different levels according to the result of the pre-assessment of knowledge and skills and anticipated competencies.

The limited knowledge on mathematics textbooks' differentiation is the gnashed of this study, hence, anchored on Maker's and Tomlinson's principles of differentiation, which have not been explored in previous researches as principles utilizing in analysing mathematics textbooks in the Philippines. Hence, this study is intended to contribute knowledge about differentiation and provides evidence on Maker's principles applied in mathematics textbook. In addition, considering the promise of curriculum differentiation in mathematics, the importance of textbooks in learning mathematics, and the limited researches on differentiation in textbooks, this study sought to answers the following research questions: What is the evidence of differentiation in locally published Grade 7 mathematics textbooks in the Philippines? Which textbooks provide more differentiation? What types of differentiation are more evident in each section of the six mathematics textbooks?

1.4. Basic education and textbooks in the Philippines

In the Philippines, the Department of Education (DepEd) is mandated to supervise the basic education program in the Philippines which consist of public and private schools. The public schools are schools owned by the Philippine government while the private schools are own by private individuals, including international schools, but operate under the mandate of DepEd (DepEd, 2010).

The shift from the 10-year to 13-year basic education program (K to12) mark the Philippines as the last country in Asia that has 10 years cycle in basic education. This created changes not just the number of years but also the content standards and features of the basic education curriculum now called as K to 12 curricula. According to DepEd (2012), the actual lesson plans and learning activities, the scope, and sequence of topics in the curricula are all arranged in the textbook.

Prior to the implementation of the K to 12 in the Philippines, textbook content was already geared closely to the national curriculum since 1984 (de Guzman, 2003). The effort to allign the content of the textbooks to the lives of the Filipinos can be tracked down in 1925, when the Monroe Commission advocated that textbooks should be suited to the learners, hence, the content and language of the Philippine textbooks should be related to the ways of the Filipinos (Vizconde, 2006). In some studies, textbooks in the Philippines are found to be significant (Glewwe, 2002) in impacting the acquisition of knowledge and skills (De Guzman, 2003; Lopez, 2008) and as primary instructional materials in teaching (Lopez, 2008). While in terms of content, Tatto and Senk (2011) relate that Grade 6 mathematics provide more learning opportunities but with low Mathematical Content Knowledge and these opportunities include aspects of curricula, instructional materials, instructional experiences, as compared to other countries. However, there is an evidence that textbooks in the Philippines provide negative impact to students due to restricted and lack of exposure to diverse problems in a textbook (Bautista, Mitchelmore & Mulligan, 2009).

In terms of textbooks quality, since 1995 up to the present, the Instructional Materials Council Secretariat is mandated to formulate and adopt policies and guidelines, in the development, evaluation, and procurement of textbooks and other instructional materials under the supervision of the DepEd to ensure textbook quality. The policies, guidelines and standards are applied to all local publishers whether their textbooks are to be used by public or private schools before these textbooks can reach the consuming public.

2. Method

2.1. Qualitative content analysis

Qualitative content analysis was applied to the analysis of six of the Grade 7 mathematics textbooks used in the Philippines. Qualitative content analysis is a systematic approach to evaluate data through coding and quantification of relevant statements (Huiberts, Hjørnevik, Mykletun & Skogen, 2013) and significantly congruent to the pre-conceived categories (Elo & Kyngäs, 2010) is utilized. In this paper, a directed approach to content analysis (Huiberts, et al, 2013) was adopted, using the guiding principles of Maker's Model of differentiation (Maker & Schiever, 2010) through *apriori* codes.

2.2. Selection and study site

In the Philippines, five local publishers have distributed Grade 7 mathematics textbooks under the K to 12 curricula. Out of five publishers one produced two Grade 7 mathematics textbooks while the other publishers published only one Grade 7 mathematics textbook. All textbooks analysed in this study are locally published by Filipino owned companies and passed the quality standards in both

content and other features as per guidelines given by the DepEd. Due to the curriculum alignment practiced by the DepEd, all publishers are aware of the content standards they need to provide and they can only publish these textbooks upon compliance to all required features and standards stipulated by the DepEd. Among the six mathematics textbooks, five are available in some local bookstore or available for open public for sale, while one textbook is officially and exclusively used by public schools is not for sale. All the six Grade 7 mathematics textbooks underwent content analysis by the researchers.

2.3. Data gathering procedure

The Principal Investigator (PI) which is the first author designed textbook analysis tool which undergo validation and reliability test by the experts. The textbooks analysis tool was based on Maker Model of differentiation, which is the *apriori* of this study. The PI trained an encoder through intensive familiarization of the concept of curriculum differentiation, then, the encoder was assessed on whether she had a clear conceptual understanding of differentiated curriculum. The encoder passed the assessment and became the official encoder for this research project.

All concepts in the lessons, illustrations, diagrams, learning activities, and test items in the mastery test in the textbooks were encoded and labelled as entries for content analysis. Concepts in the lesson are easily identified because they are highlighted either in italics or in bold letters or in the pop up box. Each concept was counted as one for the purpose of tallying the overall concepts versus the concepts that were differentiated. To refer to the diagrams, figures, tables, pictures and illustrations, the PI assigned phrases such as figure above or below a particular page describing each representation, but if there was nor representation nor example to explain the lesson, the encoder simply lifted word for word the descriptions of the concepts by the author. In the learning exercises and master tests, when multiple problems referred to one objective or task, the count was only one (Van Garderen & Whittaker, 2012).

The entries were validated through auditing the final entries by checking 10 % of the total entry using the random number generator. The required 10 percent of the entries using the number generator were corrected and these underwent re-encoding, if necessary. Checking of the correct encoded entries that are unrelated, recurring and overlapping were excluded (Moustakas, 1984, cited by Yuskel & Yildrin, 2015). Thereafter, valid entries were included in the appendix page for audit of the validity of the entries (Kane et al, 2002).

To hide the real name of the textbooks and the publishers, textbooks were coded as T1, T2, T3, T4, T5, and T6, T1 for representation of Textbook 1 and so on and so forth, whereas numbers 1-23 are codes assigned to represent items in the Maker's Model of differentiation.

The features excluded from the content analysis of the textbooks in this study are the outer feature and design elements of the textbooks (Atay & Danju, 2012), since these items are not related to the focus of this study; and in terms of the categories of the theoretical framework used in this study, the fourth cluster of Maker's Model of differentiation-learning environment is excluded, because this aspect is related to the learning environment of the students such as groupings, learning areas and other thing.

2.4. Mode of analysis

Using the researcher's pre-validated theoretical categorization system of analysis (Huiberts et al, 2013), an etic approach (Headland et al, 1990) and deductive category construction were applied (Huiberts et al, 2013). Valid entries from the textbooks were initially coded manually (Rao, Vijayapushapm, Venkaiah & Pavarala, 2011) by the trained encoder according to a classification scheme stated above (Rao et al, 2011), then repeatedly the codes were verified by the PI if these are appropriately assigned in the corresponding entries. These codes are used throughout the content analysis.

Through rigorous scrutiny (Ezzy, 2002, as cited in Smith & Firth, 2011) of the textbooks under study, each item in the textbook was evaluated and tallied to determine the extent (Sood & Jitendra, 2007) of its adherence to curriculum differentiation principles. Hence, description of the extent of differentiation (DIness) of the Grade 7 mathematics textbooks is presented qualitatively and quantitatively. Significant entries were tallied and are presented in tables and graphs, while the extent of differentiation were calculated through frequencies and percentages.

To ensure the reliability of the coding, this study employed both intra-rater and inter-rater method. The PI conducted the intra-rater reliability test by repeatedly coding the significant statements from the transcribed data until it fell under the right code, while inter-rater was carried out by the first author and the second author, both familiar to this research topic, hence, reliability was calculated using Cohen's kappa value, which was computed and the strength of agreement of the two raters was taken into account (Stemler, 2001) before considering the final result of the textbook analysis.

3. Findings

3.1. General description and parts of the textbooks

In the Philippines, the Grade 7 mathematics textbooks are organized following a common structure: the topics are sequentially arranged by chapters based on key concepts and according to pre-requisites, while the lessons are organised in the same sections, namely: objectives, introduction, lesson presentation, exercises for students to practice what they have learned, and mastery test. Some textbooks provide some trivia about mathematicians and relate mathematics to real life situations, either at the opening or at the end of the chapter. The arrangement of topics is similar in the way lessons are introduced and presented while differing in the way the curriculum is enriched through various activities, trivia, and extra challenge activities. Lastly, all six textbooks are labelled as K-12 compliant, while one textbook bears the label 'Differentiated Instruction' on its cover page.

Details of the findings are presented graphically and textually below, arranged according to content, process, and product differentiation.

3.2. Content differentiation

3.2.1. Introduction of lessons

Most of the textbooks analysed in this study use real life situations in their presentation of a new topic in the form of illustrations, diagrams, and pictures. Examples of this "Mathematics is the language of Science… theories are easily accepted when they are expressed in terms of formula (illustration above shows pricing of tickets)" (T2, p.223).

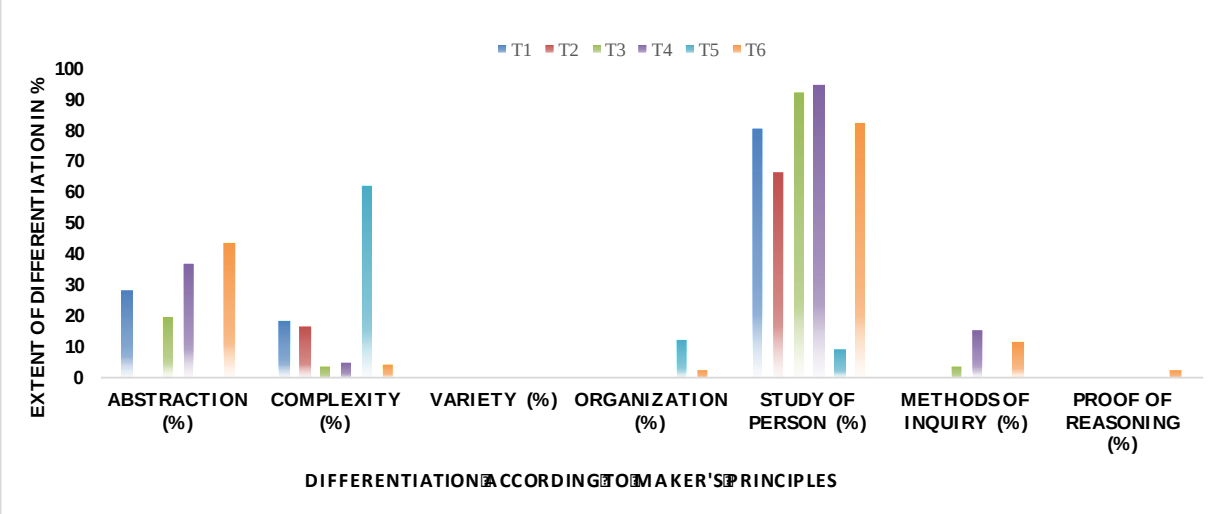

Figure 1- DI*ness* in Introduction per Textbook

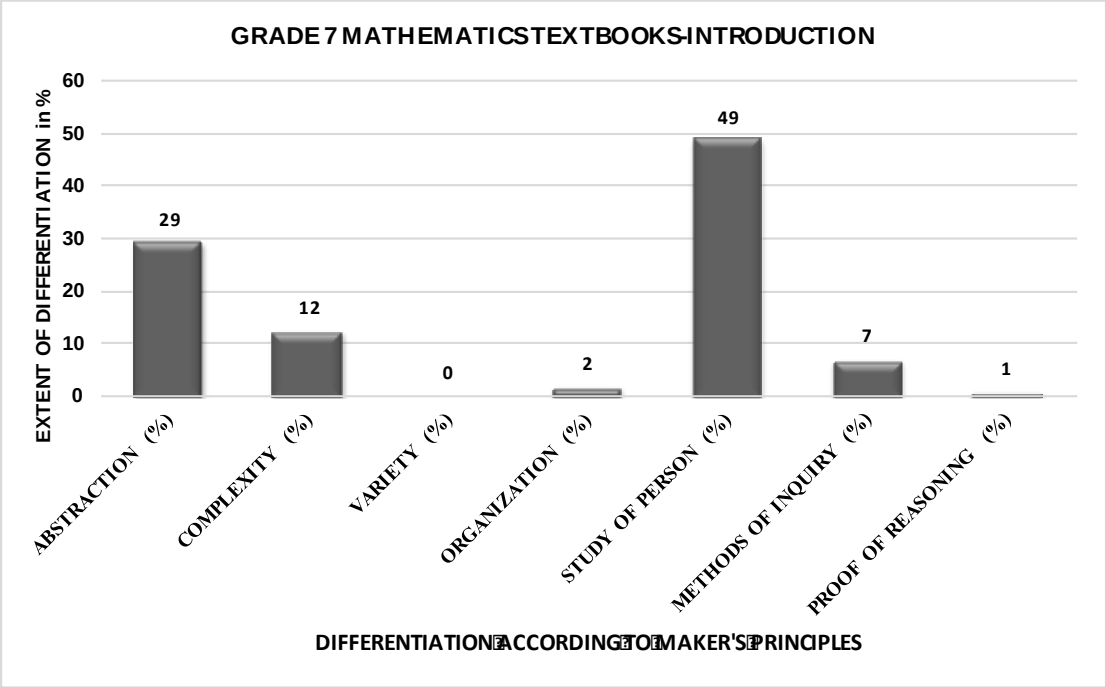

Figure 2- Graph Comparing the DI*ness* of the Introduction

Figures 1 and 2 show that in the introduction section of the lessons in the chapters, abstraction is more prominent in T6, T4 and T1; complexity is prominent in T5; organization is slightly prominent in T5; the study of person is prominent in all the textbooks, except in T5; the method of inquiry is more prominent in T4 and T6; and in the case of the proof of reasoning, only T6 shows noticeable characteristics of differentiation. Among the seven characteristics of differentiation in the Introduction, it is the real life situation which is noticeable in all the textbooks except for T5.

3.2.2. Lesson presentation

Lessons are presented with abstraction using visual prompts, illustrations, examples, provocative questions, and pictures and narrating real life situations. These provide ample visuals for students to understand the concept. Mathematical concepts are organised according to required pre-requisites and presented according to degree of difficulty. T4, T5 and T6 provide more opportunities for differentiation. Sample evidence for abstractions such as "In the above picture…A cubit is the distance from the tip of the middle finger of the outstretched hand to the front of the elbow" (T2, p.80).

Below are consolidated results of types of differentiation in terms of content differentiation in the presentation of lesson.

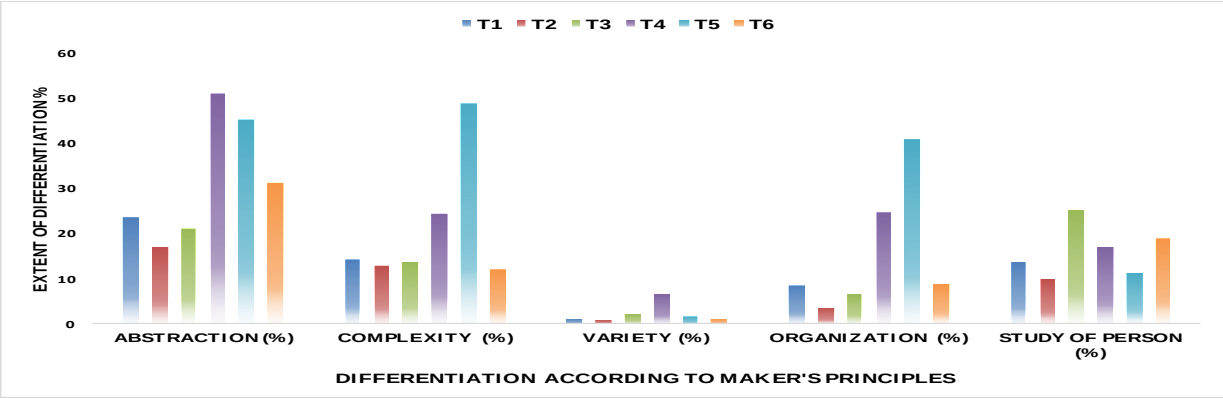

Figure 3: DI*ness* in Terms How the Lesson is Presented

As shown in Figures 3 and 4, among the six characteristics of differentiation, the following are particularly evidence: abstraction, complexity, organization, and real life situations. These are more prominent in T4, T5 and/or T6, except in the study of persons; differentiation is only prominent in T3.

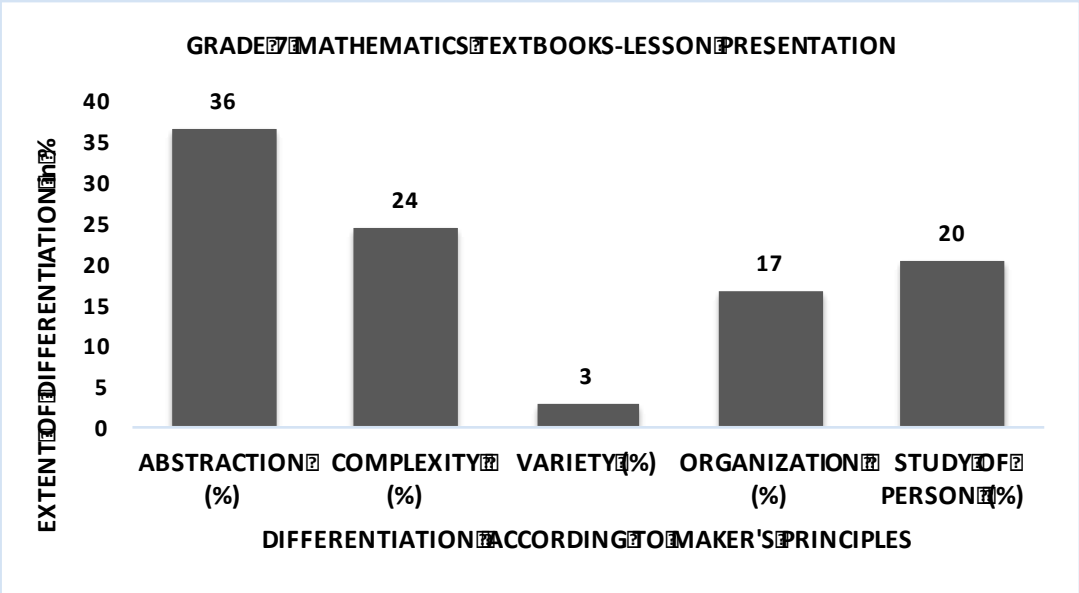

Figure 4. DI*ness* in Terms of How the Lesson is Presented

3.3. Process differentiation

The learning process component based on Maker's model of differentiation textbooks understudy is noticeable in objectives, learning exercises, and chapter test.

3.3.1. Objectives of the lesson

Objectives of the lesson in the textbooks are given before the chapter and before the unit lesson. Three out of six textbooks provide the objectives before the chapter. The objectives are in broad terms and in verb form, based on Bloom's Taxonomy. The other three textbooks provide their objectives per unit lesson. The objectives are in verb forms targeting specific competencies and skills the students should learn.

Statements which show evidence of this types of differentiation - proof of reasoning "Describe principal roots and determine whether they are rational or irrational" (T3, p60).

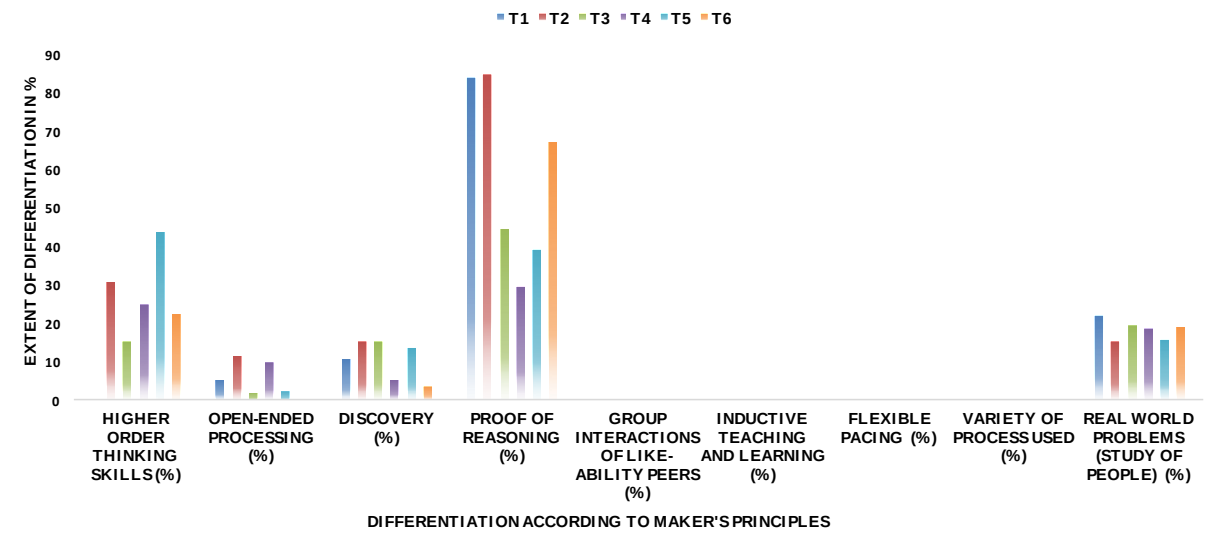

Figure 5. DI*ness* in Objective per Textbook

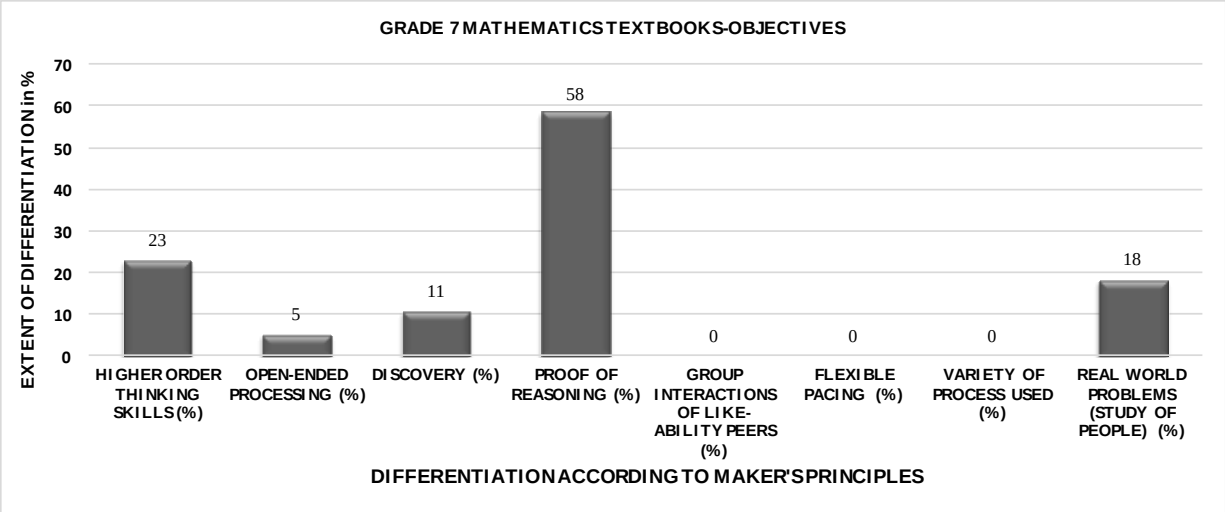

Figure 6. DI*ness* in Objectives

Figures 5 and 6 show that differentiation in proof of reasoning is obvious in T2, and T1, noteworthy also in T3 and T5; and the other differentiations noticeable in the objectives portion are the higher thinking skills, particularly in T5 and T1, and partly in T4; there is less evidence of differentiation in open-ended processing and discovery.

3.3.2. Students' learning exercises

The learning exercises are presented and organized according to level of difficulty. All textbooks present the students' learning tasks from simple to complex. Two textbooks simply present their learning exercises as "Exercises" (T4), "Practice and Application" (T2), while one textbook uses "Check Your Understanding" (T6). Three textbooks use descriptors synonymous to easy, moderately difficult, and difficult, and learning tasks that need higher thinking skills, such as "mental math" for easy learning task, "written math", and "math challenge" in T5, "establishing", "refining", and "intensifying" in T3; "follow-up practice", "Mind Strainers", "Brain Provokers" in T1. Sample of statements that qualitatively describe the items in the learning exercises: "Evaluate each expression and compare the results at the left side with those at the right side. What do you notice?" (T1, pp. 97-100).

Figures 7 and 8 illustrate significant differentiation in the learning exercises section of the textbooks under study. There is more differentiation within proof of reasoning, especially in T3 and T2, and less differentiation in T4, T1, T6 and T5; in terms of real-world problems, differentiation is more evident in T4, followed by T3, T6, T1, T2 and T5; in terms of higher order thinking skills, all the textbooks provide almost the same extent of differentiation; only T3 provides more differentiation on this matter.

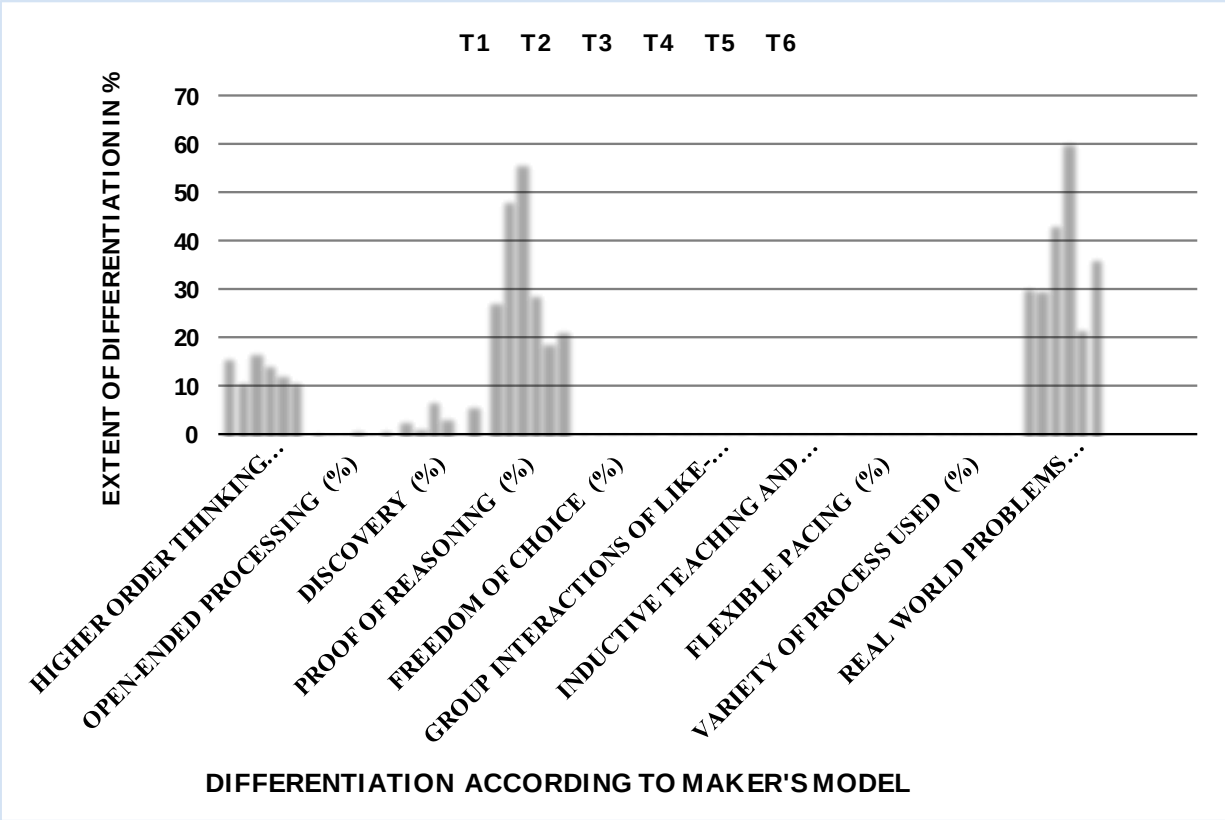

Figure 7. DI*ness* in the Learning Exercises per Textbook

Differentiation within discovery and open-ended processing are less marked, while the rest of the principles of differentiation such as freedom of choice, group interactions of like-ability, flexible facing, variety of process are not evident at all.

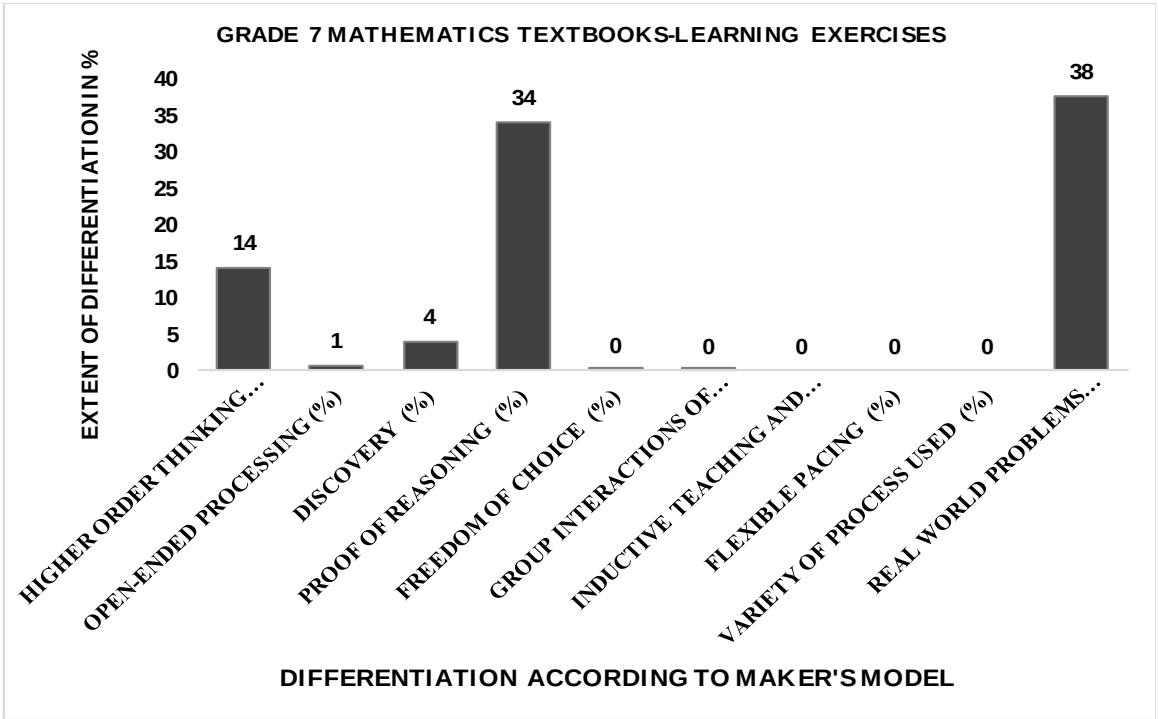

Figure 8. DI*ness* in Learning Exercises

3.4. Product differentiation

The expected learning outputs from students are articulated in the Chapter Test, Unit Project, Extra Math, and Connect with Art.

3.4.1. Chapter test

Chapter tests are mostly designed with multiple choices. Questions are based on Bloom's Taxonomy, arranged from conceptual understanding to complex items such as solving worded problems. Below are samples of statements on how the product (test items) are modified, "State in your own words the steps used to solve a linear equation" (T4, pp. 246-250).

As shown in Figures 9 and 10 in the next page, differentiation in proof of reasoning is evident in T3 and T4, and less evident in the rest of the textbooks, but they all provide modification in terms of proof of reasoning; and it is also notable with regard to higher order thinking skills.

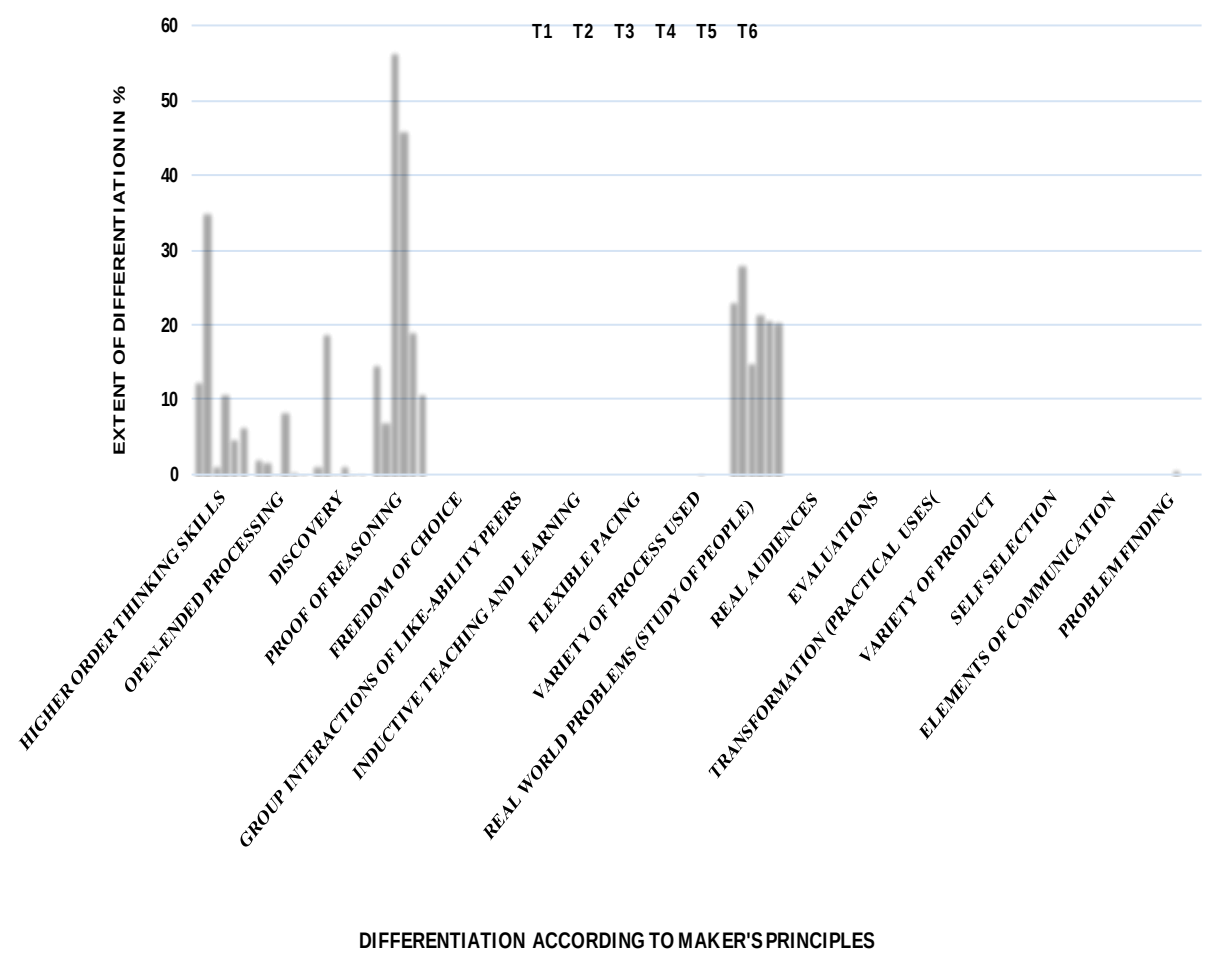

Figure 9. DI*ness* in Chapter Test per Textbooks

While less notable to the rest of the textbooks, differentiation is remarkable in T2 in terms of providing modification in discovery. T1, T4, and T6 provide limited evidence on differentiation, while T3 and T5 do not provide any modification in this matter.

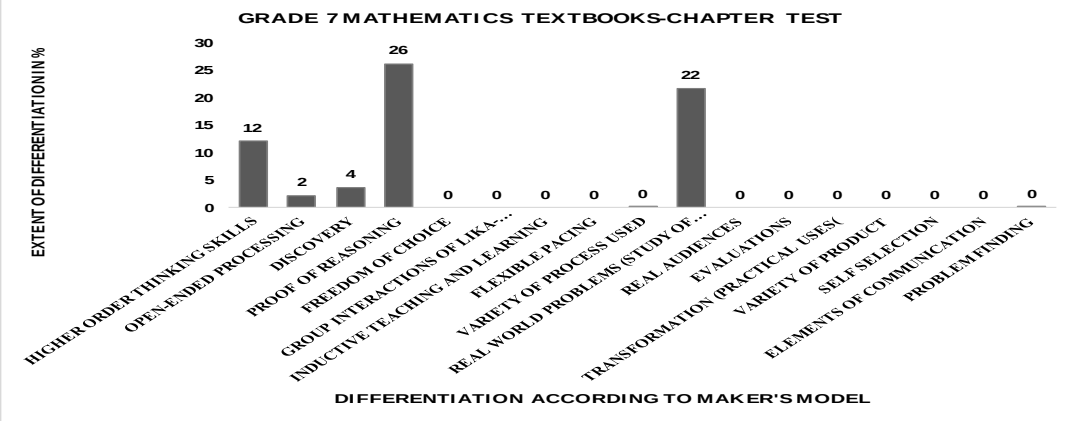

Figure 10. DI*ness* in Chapter Test

3.5. Others

Most of the textbooks understudy provided extra activities after the chapter or unit test. These are Extra Math in T5; Unit Project in T1 and T2 such as "tessellations"; Spare a Moment in T3; To Know More in T1; Integrating other learning areas like "Connect with the Art" and "Connect with Physics" in T6; and Math Trivia about Mathematicians and Mathematics in T3, T4, and T5.

3.6. Summary of results

In terms of Makers principles of differentiation, plenty of evidence in content and process types of differentiation, while limited differentiation in terms of product. The graph shows that none of the textbooks provide differentiation in all the three types, namely, content, process, and product. All textbooks under content analysis provide the same types of differentiations, but differ in the extent of differentiation. As shown in Figure 11, differentiations are clustered in similar types of differentiation; almost all textbooks provide greater differentiation on proof of reasoning; T4 provides more differentiation on real life problems and situations than T3, T6, and T1; T4 and T6 provide more differentiation on abstraction than T1, T2, T3, and T5; lastly, T5 provides greater differentiation in complexity than the other textbooks.

All textbooks provide differentiations according to Maker's principles. The most significant differentiation in terms of extent and types of differentiation are shown in Figure 11. Broadly speaking, there was more differentiation according to content and process, while less differentiation according to product. In terms of content differentiation, study of persons was the most significant, followed by abstraction and complexity; while there was evidence of differentiation in organization for learning value and variety, it was not significant when compared to the other types of differentiation under this category. The greatest extent of differentiation according to process, was in proof of reasoning followed by higher order thinking skills, while there was minimal differentiation in terms of discovery and open-endedness, while other types of differentiation such as freedom of choice, group interaction, flexible pacing and variety, were absent. In terms of product, differentiation occurred only in terms of real life situations and real world problems.

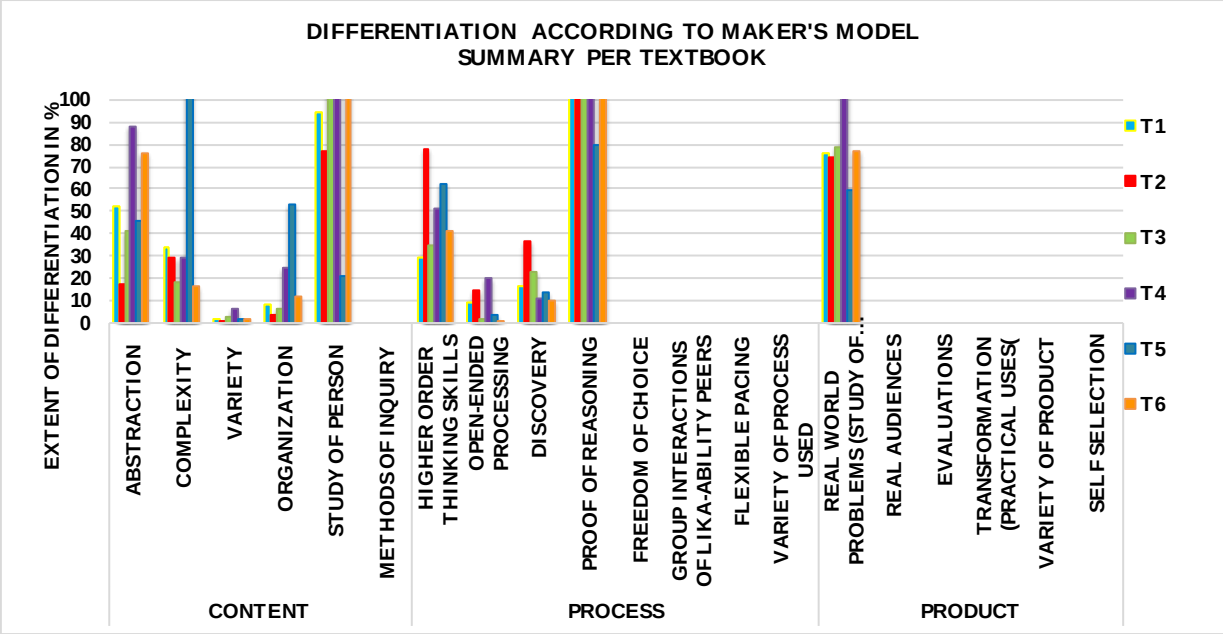

Figure 11. Summary of DI*ness* Per Textbook

The extent of differentiation in different sections of the textbook is shown in Figure 12, indicating a pattern of differentiation present in certain sections of the textbook. For instance, in lesson introductions and presentations, differentiation is more in the content. Common differentiations are in the study of people, abstraction, organization, and complexity; in objectives, learning exercises, and chapter tests, differentiation occurs more in terms of the process and product. Types of differentiations in these sections are proof of reasoning, higher order thinking skills, open-endedness, discovery, and proof of reasoning for the process differentiation, while only real world problems were evident for product differentiation in these sections of the textbook. The textbooks under study provided differentiation only according to Maker's model of differentiation, while failing to provide any scheme which would help students to understand the lessons, do the learning activities, and answer the chapter test according to their readiness, profile, and preference.

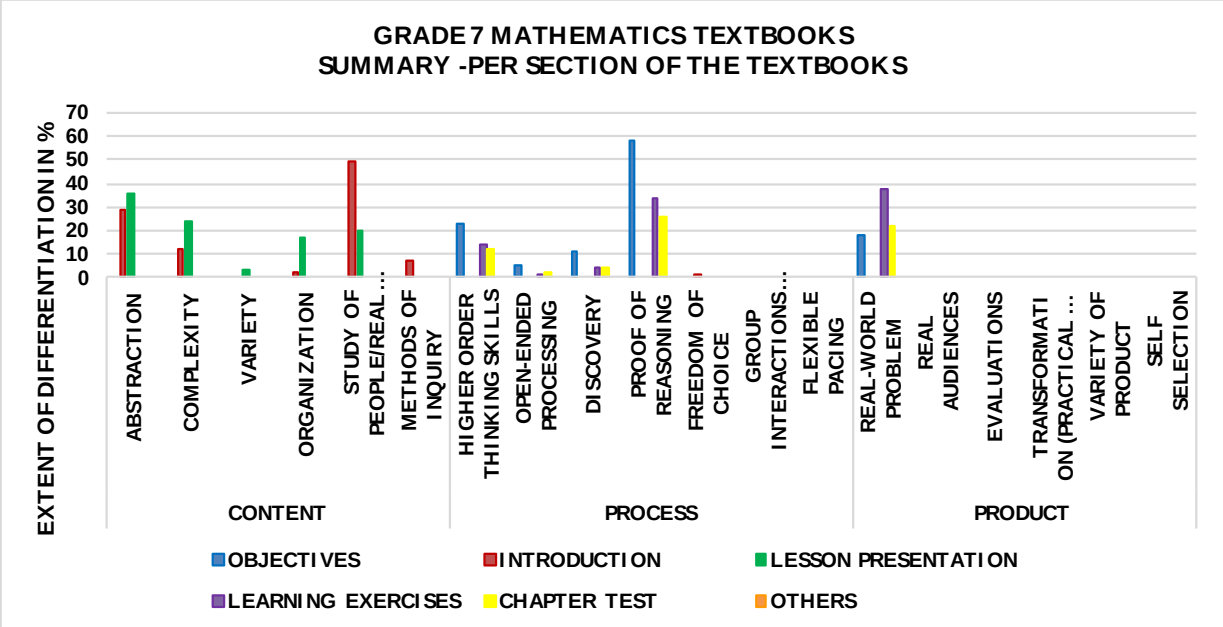

Figure 12. Summary of DI*ness* Per Section of the Textbooks

4. Discussion

Tomlinson et al. (2003) consider that differentiation addresses problems encountered in implementing the K-12 curriculum. This study sought to reveal whether the Grade 7 mathematics textbooks are differentiated in content, process, and/or product based on students' interests, readiness, and profile.

4.1. Introduction and presentation of the lessons

Topics and lessons were introduced and presented with various representations such as pictures of real life situations, diagrams, graphs, review questions, and warm-up questions.

In the introduction of the lesson, the most prominent differentiation is real life situations. This is supported by the study of Hord and Xin (2015) and Jitendra, Deatline-Buchman, and Sczesniak (2005, as cited in Goldsmith & Mark, 1999) which argues that providing real life situations supports students' understanding and establishes their thinking regarding the concept being introduced. The second most prominent differentiation in the textbooks under study is abstraction, wherein the textbooks provide graphs, diagrams, pictures and other representations. This is supported by Hord & Xin (2015) and Ma (2006) who argue that students learn new concepts best when they are introduced with visual representations and visual cues. Also, according to Nel, Kempen and Ruscheinski (2011), semi-concrete such as photographs of the real objects and picture symbols used as representation of the real object makes abstract concept less abstract. Lastly, complexity is another differentiation present in the textbooks under study. This description was supported with the study of Ma (2006) wherein new topics were introduced by working with students on problems that both refresh students' prior knowledge and foreshadow the new knowledge that students are expected to learn as a way to establish connections between prior and new knowledge.

Differentiation in lesson presentation focuses more on abstractions, complexity, real life situations, and organization. These results are also present in other researches such as in (a) abstractions according to Kelly, Pratt, Dorf and Hohmann (2013) connect the idea to the thinker, making the concept learned less abstract in their everyday learning experiences, and process with a target for students to understand the concept; and representations or symbols according to Vaughn et al. (2000) help students manipulate further; whereas, manipulative activities focus on clarifying concepts (Sood and Jitendra, 2007 as cited in van Garderen et al, 2012); (b) real life situation in the presentation of concept/s, mostly based on the real situations in the Philippine context, this description is also present in the study of Paprock, Yumol and Atienza (2006), wherein they argue that making personal connections with real situations allow students to attach meaning to numbers and to make sense of the world in a mathematical manner. Citing real life situations are presented in pictures which is supported in the study of Macintyre and Hamilton (2010) who posit that this type of differentiation plays different purposes and functions in the presentation of a context in mathematics and scaffolds students' understanding in a certain concept; (c) complexity, involves careful selection and sequencing of examples to reinforce the learning material. This finding is supported by Tomlinson (2001, cited by McCoach et al, 2014) whereby, lessons are adjusted in terms of the criteria of differentiation such as: simplicity/complexity, concreteness/abstractness, more structure/less structure, and so on ; and lastly, (d) organization, a differentiation in the textbooks under study is the least prominent, whereby, the lessons are organized around key concept clustered in chapters or units, hence, prerequisites of ideas and procedures are evident in the textbooks. This result is supported in Leinhardt's study (1989, cited by Jitendra et al, 2005), wherein he argued that this type of differentiation is intended to assist students in understanding and making connections.

4.2. Objectives

In the objectives, proof of reasoning, higher order thinking skills, real world problems, discovery, and open-ended processing skills are underlined in this study.

Differentiation according to proof of reasoning, is supported by Jitendra et al (2005) wherein learning objectives are intended to direct the performance of the students, whereby students can solve problems in multiple ways (Dougherty, Bryant, Bryant, Darrough & Pfannenstiel, 2015). In terms of higher order thinking skills, a similar result is found in Kurz, Elliott, Lemons, Zigmond, Kloo and Kettler's study (2014) where questions are in higher-order cognitive processes, and essential questions are pre-quesite to the higher level thinking skills (Beecher & Sweeny, 2008). As with the results of this

study, the objectives and content of the assessments are organised gradually from simple to complex or for beginners to advanced learners (Wen Chien, 2015).

4.3. Learning exercise

Differentiation in learning exercises is more on proof of reasoning, real world problems, higher order thinking skills, and discovery. In terms of proof of reasoning, the textbooks provide learning exercises intended for students to practice the concepts learned and teachers can check if the students really learn the concept being taught (Calhoon, 2008). Trafton (1983, cited by Jitendra et al, 2005) also found that when students do not receive sufficient practice with varied examples, they are likely to make errors, while on the other hand, more examples maximize opportunities for students to respond (Mastropieri, Scruggs, Norland, Berkeley, McDuffie, Tornquist & Connors, 2006), especially with exercises that need reasoning (Ma, 2006). This is supported by Bautista et al.'s study (2009; Gersten & Baker, 1998, cited by Jitendra et al, 2005), in which they analyse examples used to expose diverse types of problems so that students are not restricted to understand the lesson. In terms of real world problems, Trafton et al. (2001, cited by Stylianides & Stylianides, 2007), present similar results, that well-designed real-life tasks stimulate student interest and engagement and develop positive view of mathematics as a useful discipline. In terms of higher order thinking skills, learning exercises are organized according to Bloom's Taxonomy. This is supported by Ghamrawi' study (2014) and Simpkins, Mastropieri and Scruggs (2009), who argue that learning exercises presented in an appropriate skill level result in higher test scores. In this form of differentiation, students demonstrate prior knowledge often known as differentiation by readiness (Tomlinson, 2001, Tomlinson & Jarvis, 2009), or Tiered activities (Tomlinson, 2001) allow students to work with different levels of initial knowledge and skills to master (Tomlinson, 2001, cited by McCoach et al, 2014). Lastly, in terms of discovery- textbooks understudy provide learning exercises that students need to do through discovery. This is supported by Ma (2006), who stresses that differentiation is to promote active engagement of students in the construction of their own knowledge. In addition, Ma (2006) argued that creating a problem-rich environment facilitates the construction of various connections between prior and new knowledge. Likewise, in Maeng and RanBell's study (2015), learning exercises are intended for students to develop students' understanding of the important ideas of the content and discover them through related and prerequisites learning activities. Xin's study (2008, cited by Hord & Xin, 2015) also shows that using model equation in solving world problems promotes students' conceptual understanding and facilitates students' solution as they solve word problems.

4.3. Chapter/unit test

Differentiations provided in chapter or unit test section are almost the same as differentiations provided in learning exercises section, namely: proof of reasoning, real world problems, higher order thinking skills and discovery.

Differentiation in terms of proof of reasoning is discussed by van Garderen and Whittaker (2006), wherein students' products give students several opportunities to demonstrate their learning. Likewise, the results found regarding real world problem differentiation is also found in Trafton et al (2001, cited by Stylianides & Stylianides, 2007). Lastly, higher order thinking skills are discussed by Simpkins et al, (2008), who posit that tests should be adjusted according to difficulty to keep the students challenged.

5. Conclusion

Kaplan (2007) stresses that differentiated curriculum acknowledges multiple goals that respond to the abilities, needs, and interests of students, and Simpkins et al. (2009) posit that with diversity increasing in regular classrooms (Mastropieri & Scruggs, 2007), instructional materials should be enjoyed by all students and must have the potential to engage them academically. This study posits that all Grade 7 mathematics textbooks in the Philippines provide the same types of differentiations according to Maker's principles of curriculum modification in terms of content, process, and product, and differ in the extent of differentiation. The pattern created by the extent of differentiation clusters around certain dimensions. Content differentiation is clustered in lesson introductions and

presentations; process differentiation is found in the objectives of the lesson and in learning exercises; whereas, product differentiations are clustered in the mastery test and other extra learning activities, such as project making. In addition, all Grade 7 mathematics textbooks provide different appropriations of differentiation. Some textbooks are more inclined to complexity types of differentiation, some on abstractions and most place more emphasis on real life situations in terms of type of differentiation.

Though the Grade 7 mathematics textbooks analysed provide differentiation to some extent and some types of differentiation according to Maker's Model, the textbooks under study do not fully respond to the abilities, needs, and interests of students, yet these differentiations can be practically used in appropriating learning activities such as in practice exercises and mastery tests because learning activities and mastery tests in the textbooks under study are organized according to the level of difficulty. The findings of this study add to the body of knowledge regarding mathematics textbooks differentiation; a benchmark of evidence of Maker's principles applied differentiating in mathematics textbook; and the details of the findings can be used as data for future researches specially in textbooks differentiation in mathematics and comparative purposes.

The limitation of this study is that analysis is only based on the theoretical framework of Maker's Model of Differentiation and Tomlinson's principles, which favour qualitative investigation. Further studies could therefore adopt a quantitative approach towards the effect of textbooks differentiation on students.

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