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An Assessment of Grade 8 Geometry Teaching Guide of the K to 12 Basic Education Program Based on Van Hiele Model of Geometric Thinking and Department of Education's Standards

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Abstract Using the descriptive method of research, this study focused on the assessment of the Grade 8 geometry teaching guide of the K to 12 Basic Education Program based on the van Hiele model of geometric thinking and Department of Education's standards. The four modules of the teaching guide namely: Reasons Behind Reasoning, Triangle Congruence, Inequalities in Triangles, and Parallelism and Perpendicularity were assessed vis-a-vis the levels of thinking: Level 0 (Visualization/Recognition), Level 1 (Analysis), Level 2 (Ordering), Level 3 (Formal Deduction) and Level 4 (Rigor). The learning competencies, instructional activities and assessment tasks were classified according to the levels. Frequencies and percent values were used to analyze the presence of the levels in the teaching guide. In assessing the consistencies, as well as the presence of some features necessary for geometric instruction, DepEd's levels of assessment or the Knowledge, Process, Understanding and Products (KPUP) framework was used. It was found out that in terms of the model, the teaching guide bordered on Analysis, Ordering and Formal Deduction. Recognition, and Rigor were given less emphasis in the teaching guide. The guide is commendable for the comprehensive presentation of relevant learning activities and its tendency towards the development of higher order thinking skills. However, there were inconsistencies in the use of the DepEd's KPUP model. It is recommended that the DepEd may consider the use of the model as a framework to develop the teaching guide's components. It is also recommended that future researchers consider results of the instruction based on students' van Hiele levels of thinking.

Keywords: *assessment, teaching guide, content analysis, geometric thinking*

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1. Introduction

The K to 12 Basic Education Program in the Philippines has been implemented by the Department of Education since the school year 2012-2013. The new mathematics curriculum of the program has provided new directions for mathematics instruction. The aim of the curriculum to develop the students' critical thinking and problem solving capabilities demands comprehensive teaching strategies reflecting rigorous curriculum, well-defined set of high order thinking skills and learning process which require the use of appropriate tools [4]. To achieve such aim, DepEd created teaching guides for teachers to use and follow. Last Summer 2013, Grade 8 teachers were given the opportunity to use the guides.

Geometry as one of the strands of Grade 8 mathematics includes the properties of two– and three– dimensional figures and their existing relationships, spatial visualization of the figures, reasoning and geometric modeling and proofs of theorems, axioms, postulates and the like. From the brief description, Grade 8 students are required to demonstrate understandings of axiomatic development of geometry, triangle congruence, inequalities in triangles, and parallel and perpendicular lines [5]. Engaging students in these areas will much more likely require teaching and learning of abstract ideas. Since geometry is said to be abstract, depth in mastery may be achieved through effective transition of the classroom activities by recognizing the students' level of understanding of every topic at hand.

The van Hiele model of geometric thinking gives us a clear understanding of determining the competency achieved by the student in learning geometry as developed by Dina van Hiele-Geldof and Pierre Marie van Hiele. The authors suggested that the model can guide instruction and at the same time, the assessment of student learning aside from its main use of determining the processes involved in

the learning of geometry [3]. For each instruction to be effective, the teachers should be informed about the levels of learning to be able to develop teaching strategies that will adress to developmental learning [1]. The NCTM Curriculum and Evaluation Standards for School Mathematics [6] suggested the development of geometric ideas progresses through a hierarchy of levels and that curriculum planners must consider this suggestion.

The teaching guide includes all the learning competencies, goals and targets, all the strategies, teaching methods and approaches as well as potential materials and assessment tools which are recommended to be used in the actual classroom setting. Crawford [2] stated that alignment of these components of a curriculum will not only help the classroom teacher but also the teachers for the next grade level. If the teaching guide that plays the main tool of a teacher to convey the topics in Grade 8 geometry reflects the van Hiele model, then the teaching and learning process that will occur is developmental. If there is progressive organization of geometric ideas, geometric learning will be successful. Since the teaching guide is used nationwide, an assessment should be done to ensure that this guide will initiate effective geometric learning through the van Hiele model. Also, considering the general principles and guidelines in curriculum planning and the requirements set by DepEd for K to 12 BEP, the teaching guide's adherence to such standards must also be ensured.

The study then tried 1) to determine the van Hiele levels of thinking present in the Grade 8 geometry teaching guide in terms of the learning competencies, instructional activities and assessment, 2) to identify consistencies and inconsistencies in the features of the teaching guide based on general principles on curriculum planning and requirements provided by the DepEd, and 3) to propose enhancements based on the van Hiele model of geometric thinking and DepEd's standards.

2. Methodology

The study used descriptive method of research using content analysis as a technique. This study analyzed available teaching modules in Grade 8 geometry. The modules are *Reasons Behind Reasoning*, *Triangle Congruence*, *Inequalities in Triangles*, and *Parallelism and Perpendicularity*. The learning competencies, instructional activities and assessment items of the modules were scrutinized using the van Hiele model as the main guide. Consistencies and inconsistencies were also determined especially on the use of the Knowledge-Process-Understanding-Product (KPUP) Model. Each instructional objective, learning activity and assessment item was rated using the following notations:

Table 1. Criteria Used in Analyzing the Level of Geometric Thinking Present in the Teaching Guides

SKILLS	Level 0: Recognition	Level 1: Analysis	Level 2: Ordering	Level 3: Deduction	Level 4: Rigor
VISUAL	Recognizes different figures from a picture; Recognizes information labeled on a figure.	Notices properties of a figure; Identifies a figure as part of a larger figure.	Recognizes interrelationships between different types of figures; Recognizes common properties of different types of figures.	Uses information about a figure to deduce more information.	Recognizes unjustified assumptions made by using figures; Conceives of related figures in various deductive systems.
VERBAL	Associates the correct name with a given figure; Interprets sentences that describe figures.	Describes accurately various properties of a figure.	Defines words accurately and concisely; Formulates sentences showing interrelationships between figures.	Understands the distinctions among definitions, postulates, and theorems; Recognizes what is given in a problem and what is required to find or do.	Formulates extensions of known results; Describes various deductive systems.
DRAWING	Makes sketches of figures accurately labeling given parts.	Translates given verbal information into a picture; Uses given properties of figures to draw or construct the figures.	Given certain figures, is able to construct other figures related to the given ones.	Recognizes when and how to use auxiliary elements in a figure; Deduces from given information how to draw or construct a specific figure.	Understands the limitations and capabilities of various drawing tools; Pictorially represents nonstandard concepts in various deductive systems.
LOGICAL	Realizes there are differences and similarities among figures; Understands conservation of the shape of figures in various positions.	Understands that figures can be classified into different types; Realizes that properties can be used to distinguish figures.	Understands qualities of a good definition; Uses properties of figures to determine if one class of figures is contained in another class.	Uses rules of logic to develop proofs; Is able to deduce consequences from given information.	Understands the limitations and capabilities of assumptions or postulates; Knows when a system of postulates is independent, consistent and categorical.
APPLIED	Identifies geometric shapes in physical objects.	Recognizes geometric properties of physical objects; Represents physical phenomena on paper or in a model.	Understands the concept of a mathematical model that represents relationships between objects.	Is able to deduce properties of objects from given or obtained information; Is able to solve problems that relate objects.	Uses mathematical models to represent abstract systems; Develops mathematical models to describe physical, social, and natural phenomena.

The rates in each module were classified under learning standards, activities and assessment. The number of learning competencies (LC), instructional activities (IA) and assessment activities (AA) were determined. Frequencies and percent values were obtained in each part. To make the study more relevant, the DepEd standards were also considered. Two raters rated each module and resolved the differences in rating by discussing the logic behind the classifications.

3. Results and Discussion

After careful assessment of the teaching guide, the following results were obtained:

Table 2. Summary of Emphasis for van Hiele Thinking Skills in LC, IA and AA of the Modules

	Module 6	Module 7	Module 8	Module 9
LC	Deduction	Ordering & Deduction	Analysis & Deduction	Deduction
IA	Deduction	Analysis	Ordering	Deduction
Diagnostic AA	Analysis	Recognition	Analysis	Deduction
Formative AA	Analysis	Recognition	Ordering	Deduction
Summative AA	Ordering	Ordering	Analysis	Ordering

Module 6 aligned its instructional activities to its learning competencies. However, the assessment activities were not aligned according to the van Hiele thinking skills. Diagnostic assessment emphasized Analysis and considering the learning competencies, students were expected to have reached Analysis before proceeding to what is expected of them which is Deduction. Moreover, the formative assessment emphasized Analysis which is not compliant to the emphasis on the instructional activities. Since this assessment is done during the learning task, there is no alignment between the two. For the summative assessment, Ordering was emphasized.

Module 7 has different emphases in each component of the teaching guide. The learning competencies expected students to reach Ordering and Deduction at the end of the module but its instruction part has more Analysis activities. Although Analysis is one level below Ordering and two levels below Deduction, mastery on this level does not guarantee a student to reach the next levels. If a student is expected to reach such levels, he must be exposed to activities higher than Analysis. The diagnostic and formative assessments also were not aligned since the emphasis for both is Recognition or Visualization. The summative assessment, however, was aligned with the learning competency.

For Module 8, three thinking skills were emphasized: Ordering, Analysis and Deduction. The learning competency expected students to reach Analysis and Deduction level at the end of instruction. The instruction emphasized Ordering. Analysis may be improved but Deduction was not given the focus in the instruction. However, diagnostic and summative assessments were aligned to each other and to the learning competencies. These assessments measure what is expected of the students. Furthermore, the formative assessment was aligned to the instructional activities.

Module 9 has a more consistent emphasis which is Deduction for learning competencies, instructional activities, diagnostic assessment and formative assessment. However, at the end of the module, students are assessed more on the Ordering level which is a step lower than Deduction in the hierarchy. Considering that Module 9 is the end of geometry in Grade 8, it emphasized its expectations from students to reach Deduction in their geometry. Also, proofs are emphasized in the discussion of geometry based on the subject matters and according to the van Hiele model, proofs are much understood if students are exposed to Deduction activities.

Rigor was given less emphasis in the teaching module for Grade 8 geometry. This evidence is reflected in the first recommendation of Ivan Niven [7] in how geometry can survive in the secondary curriculum. Considering that Grade 8 geometry are only starting concepts towards higher axiomatic systems, Niven stated that teachers should treat beginning geometry such as algebra and calculus without excessive emphasis on rigor. Also, it can be seen that Deduction occurred most frequently in the teaching guide. Deduction level as described by Crowley [3] is an opportunity for students to demonstrate understanding of the axiomatic system of establishing proofs which is also the focus of the teaching guide. Niven also has one recommendation that supports this data. He recommended that geometry should be taught with the heart of the subject as soon as possible to further understand the subject matter and work on the foundation to be able to step higher on the subject.

4. Conclusions and Recommendations

Generally, the teaching guide for Grade 8 geometry has various thinking skills and focus when classified according to the descriptors. Considering the three components of the teaching guide, Deduction-Logical was found to have the highest frequency in the modules except for Module 7. However, Verbal geometric skill was found in all modules.

Considering the DepEd's standards, instructional activities are comprehensive and include real-life and challenging examples, reflection activities and Internet-based supplementary activities; however, there is no time-frame for the different activities. Also, activities were not classified according to the KPUP model.

Assessment is focused on higher order thinking skills. In terms of format, assessment maps and assessment matrices have different formats and contents in the different modules although item placement was present in the assessment maps. Modules 6 and 7 have no post-assessment for the whole module. In the pre-assessment and post-assessment items, some were classified under KPUP model and have explanations for the answers while some were not. Therefore, there seems to be some inconsistencies in the use of the KPUP model in the learning objectives and activities, and assessments. The levels of activities and assessments do not coincide with the standards.

The strongest feature of the teaching guide is best manifested in the learning activities. The activities focused on real-life situations needed by the students for them to see the relevance and application of geometry. Moreover, the guide's partiality to higher order thinking skills is another plus factor. The classifications conducted in this study as well as the spiral design of the K-12 Curriculum indicate the possibility that the van Hiele model can be used as a framework to develop the components of the teaching guide to emphasize the increasing complexity of the subject matter. As studies have shown, thinking skills are developed in a hierarchical manner.

The following enhancements are being proposed for the maximum realization of the goals of teaching-learning of geometry:

1. Rigor should also be given more value to enhance students' skills in coping with life's challenges. Also, since Formal Deduction was given more emphasis in the teaching guide, activities on the prior levels should be given to promote mastery of the prerequisite knowledge and skills needed to be successful at the succeeding levels. The alignment of the components should also be given considerations.
2. Since DepEd emphasizes KPUP model, the department should be consistent with the format and features of the teaching guide especially in the use of the KPUP model in all the learning competencies, instructional activities and assessment for teachers to have an easier grasp of the teaching guide. Furthermore, the guide may be provided with estimated time frame for each activity for smooth planning, scheduling and implementing.
3. More specific learning objectives must be also included before each instructional activity to guide every teacher and to create uniformity among them. In this way, all students will be directed to a uniform goal and will be able to experience equal opportunities in learning geometry.

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References

[1] Agno, L. N. (2009). *The learning process.* Principles of Teaching 1: A Modular Approach. Quezon City, Metro Manila: C&E Publishing, Inc.

[2] Crawford, J. (2011). *Do you have three curricula?* Using Power Standards to Build An Aligned Curriculum: A Process Manual. California: Corwin: A SAGE Company

[3] Crowley, M. L. (1987). The van hiele model of the development of geometric thought. *Teaching and Learning, K-12 – 1987 Yearbook.* Virginia, USA: NCTM.

[4] DepEd Order No. 31, s.2012. Policy Guidelines on the Implementation of Grades 1 to 10 of the K to 12 Basic Education Curriculum (BEC) Effective School Year 2012-2013. Office of the Secretary, Department of Education, Pasig City.

[5] K to 12 Curriculum Guide, Mathematics, Grade 1 – 10 (2012). Diliman, Quezon City: University of the Philippines – National Institute of Science and Mathematics Education (NISMED).

[6] National Council of Teachers of Mathematics. Commission on Standards for School Mathematics. (1989). Curriculum and evaluation standards for school mathematics. Natl Council of Teachers of.

[7] Niven, I. (1987). Can geometry survive in the secondary curriculum? *Teaching and Learning, K-12 – 1987 Yearbook.* Virginia, USA: NCTM.