

Designing framework of interactive pictorial maps to promote analytical thinking topic on weighing and measuring

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Received 7 August 2015; Revised 31 August 2015; Accepted 1 September 2015; Available online 1 October 2015

ABSTRACT

The purpose of this research is to synthesize the theoretical framework and designing framework of interactive pictorial maps to promote analytical thinking. Research design is documentary research. The procedures were as follows: 1) to examine and analyze principles and theories of designing tools for Prathomsuksa 2 students 2) to synthesize theoretical framework and designing framework of interactive pictorial maps to promote analytical thinking. The result revealed that the theoretical framework consists of 4 foundations: 1) Graphic design and designing tools for learning, 2) Psychological base, 3) Analytical thinking base, 4) Mathematics base topic on weighing and measuring. The designing framework of interactive pictorial maps to promote analytical thinking topic on weighing and measuring comprises of 5 components as follows: 1) learning tools about weighing and measuring, 2) problem analysis, 3) classification and relationships, 4) linking ideas by using interactive pictorial maps, 5) analyze and the correct answers by using interactive pictorial maps.

Keywords: interactive pictorial maps, analytical thinking, weighing and measuring

INTRODUCTION

“Children in classroom have different perspective formed by their classroom experiences mostly” (Acar, 2012). By considering children’s vision, Chula (as cited in Acar, 2012) investigated the discovery of

children's vision, their perception of their ideal worlds and drawing as tools of “projection”. Kennedy and Tipps (1994) suggested that “the value of a manipulative is in its use”, manipulative enable students get concepts through their experiences, require students to engage in a problem or situation

and help students encourage mathematics embedded in materials. Ideas by the using instructional materials, the pictorial icon has approved the choice of greater subject and could be applied to the teaching of complex working procedure in the same place (Uttal, Scudder & Deloache, 1997).

Pictorials have shown a characteristic or a famous feature to the most relevant information that vantage point to the viewer's attention and stated that the greater amounts of information and detail (Mcdougald & Wogalter, 2014). In some case, it has often been stated that “the picture is worth a thousand words or thousand number” (Grishin, Sula & Ulieru, 2003). The study about iconic pictorial, Sung and Hu (2006) has shown the user can drop the need for repeated image understanding if using the logical picture. The operation for spatial of symbolic images like a restoration useful offer in environments and the physical picture like a stored at each local site. Only the transform of image store to the local site that is essential their logical picture by relation. The study highlight the fact that the pictorial and drawing is a concrete icon; the best score from comparing all scores. The showing of pictorial-base icon from similar past research confirmation, this could be due to the high parallel processing of concrete image than an abstract image (Kunnath, Cornell, Kysilka & Witta, 2007).

In previous research, Bloom (1956) investigated the operation stage of children “A concrete operational stage (7-11 years) during which children develop skills to think logical about concrete event.” Ideas by Uttal, Scudder and Deloache (1997) revealed that the concrete object has designed exactly to help students learn mathematics. The interactive is learning with concrete objects has sparked the attention by using mathematics manipulative supported the idea about students learn the best with interactive.

The concrete object offers the method around the vagueness of written mathematical symbols (Uttal, Scudder & Deloache, 1997). The study of mathematics in the past about learning and teaching mathematics in the school, mathematics has been motivated for students can help them learn to the reason and apply for daily problem (Thipathi, 2009). In the study daily experience of students by Uttal, Scudder and Deloache (1997) have shown that concrete allow student found attachment between their daily experience and their first knowledge about mathematics concept and symbols that many people want to reform the instructional of mathematics advance to using concrete objects.

The concept of achieving manipulative-base problem solving in the classroom has supported by the development higher level thinking skill and fluency and flexibility with numbers in young students (Kelly, 2006). The

ability of thinking is very important for student’s learning. Bloom (1956) found that the competency of analytical thinking, people would be associated the relationship, identifying and classifying difference aspect of anything which might be an object as a story and the incident cover a small part. Howard, Magee, Shin and Shia (2001) demonstrated that “Good student” is the stereotype of high analytical ability of student, this ability are needed to analyze, evaluate, explain, and compare or contrast.

The review of literature also revealed that the design learning materials (interactive pictorial maps) to create a new experience for the students and relevant student's perception, learning by using materials (Pictorial, concept map, iconic picture, symbolic) to help them understand core concepts in learning subject especially in mathematics. Mathematics subject is very important for logical content and solving problems in student learning consistent promotion of analytical thinking. An analytical thinking, it emphasizes the student's skills needed to reason through the decision and problem inherent learning excellent in the concrete stage.

OBJECTIVES OF THE STUDY

1. To examine and analyze principles and theories of designing tools for Prathomsuksa 2 students
2. To synthesize theoretical framework and designing framework of interactive

pictorial maps to promote analytical thinking.

MATERIALS AND METHODS

Research Instruments

The instruments used of in this study were 2 kinds as following details:

1. Document analysis worksheet for analyze the background resource about graphic design and designing tools for learning, psychological base, analytical thinking base, and mathematics base topic on weighing and measuring.
2. The questionnaire to evaluate the Item Objective Congruent (IOC) for the expert review for evaluation of designing framework, the questionnaire to evaluate the quality of learning content about mathematic topic on weighing and measuring, and the questionnaire to evaluate the quality of interactive pictorial maps (tool).

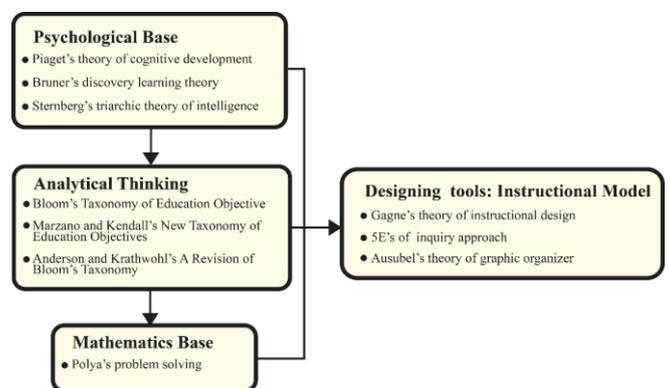


Fig. 1 Theoretical framework of interactive pictorial maps to promote analytical thinking

This study about designing interactive pictorial maps, the researcher need to

understand the concept and basic design for develop a learning tool. Therefore, the theoretical framework can be a guideline for develop concept in designing framework of interactive pictorial maps. In designing the phase of interactive pictorial maps following research process namely:

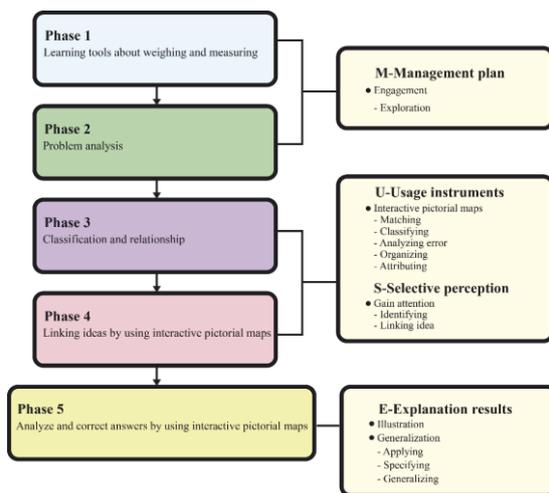


Fig. 2 Designing framework of interactive pictorial maps to promote analytical thinking

Process 1: Planning

The planning framework and work process are relevant to the real problem of the target groups and make the most of existing opportunities and benefits generated by the research follows 5 steps:

Step 1 identification is a participation consultative process that analyzes the situation and the problem, the essentials and support or argue topics.

Step 2 once the situation has been analyzed and understood, should establish concrete outcome to achieve, and outline the action to be taken and resources needed. It

should also establish proper indicators for each objective.

Step 3 analyzing the situation, formulating the strategy and structure, prepare the implementation and planning the stage of tool and create the designing framework.

Step 4 summarize knowledge and gain insights from designing tool, implementation plan will be devised based on the theoretical framework to have both a results-based work plan.

Step 5 planning the monitoring and evaluation system.

Process 2: Studying

Researcher study the document for guiding in the core concept of theoretical and designing framework of interactive pictorial maps base on (graphic design and designing tools for learning, psychological base, analytical thinking base, mathematics base topic on weighing and measuring), study about data management begin at the start of the study design stage and cover the following the core concept of tools, study about the item affected positively or negatively by the problem, study step operation research in material and student behavior in learning from usage instrument.

Process 3: Designing

The researcher will make sure the learning theories adopted in design phase on designing tools framework follow designing learning

steps of instrument; the process of designing learning steps divided into main division which support analytical thinking (analysis of element, relationships and organizational principles). Researcher design the stage to explore the need or problem in mathematics especially to student's analytical thinking. The designing interactive pictorial maps focus on pictorial design to attractive student interesting and offer the concept illustrate about information. The design of explanation result about concrete answer has described by selecting pictorial, pictorial maps, symbol and writing short answer.

Process 4: Reflecting

Students were used the sample practice to reflect on how using the pictorial maps help them understand the text for problem analysis. The framework also will make sure for students have a proper tool design to learn and able to make a good performance. This tools will give students develop their analytical thinking by using interactive pictorial maps. Students will reflect from the learning steps, believe that this is a good position to solving problem in mathematics topic on weighing and measuring successfully and enhances student have excellent analytical thinking. The reflection provides the guide to contribution or improvement in another part as tools, learning record, questionnaire, practicing reveal the activity in the classroom.

RESULTS

Researcher found that the Theoretical framework of interactive pictorial maps to support student learning. The theoretical framework consists of 4 foundations:

- 1) Graphic design and designing tools for learning; several graphic designing and graphic organizer theories. The designing tools (graphic, pictorial, pictorial maps, iconic and symbolic) used in this study helps students to enhance analytical thinking in concrete perception.
- 2) Psychological base; the psychological with underlined this framework guide to understand a characteristic of students, perception, emotion, reflection on their learning in a concrete operation stage.
- 3) Analytical thinking base; based on information gathered and adapted from the sources list and pictorial at the end. This stage is very important to learning ability relevant situation, practice, problem, statement, ideas, arguments of student's thinking with a logic to concrete.
- 4) Mathematics base topic on weighing and measuring; this is important to design a learning tools with curriculum and subject content. Students must understand the problem and condition. In the planning about

solution, student should find the connection between the data and the unknown. They should check each step and prove the correct answer. Final, they should check the solution obtained (looking back).

The researcher has designed item format and specifications items in the core concept of analytical thinking. The theoretical framework which used as foundation in analyze, synthesizing the design framework of interactive pictorial maps to promote analytical topic on weighing and measuring follows:

Phase 1 learning tools about weighing and measuring: students study statement about topic weighing and measuring (engagement). After that, they can explore and study tools for weighing and measuring (Exploration). It is illustrated the relationship between underline theories as follows: Gagne's theory of instructional design, 5E's of inquiry approach. This phase is the stage scope management plan.

Phase 2 problem analysis: students study statement and question about topic weighting and measuring (engagement). After that, they can read information in the question and see pictorial map to analyze the question topic on weighing and measuring (Exploration). It is illustrated the relationship between underline theories as follows: Polya's problem. This phase is the stage scope management plan.

Phase 3 classification and relationship: students using interactive pictorial maps to matching, classifying, analyzing error, organizing and attributing in the practice. It is illustrated the relationships between underline theories as follows: Bloom's Taxonomy of Education Objective, Marzano and Kendall's New Taxonomy of Education Objective and Anderson and Krathwohl's a revision of Bloom's Taxonomy. This phase is the stage scope usage instrument and selective perception.

Phase 4 linking ideas by using interactive pictorial map: students study in learning activity and practicing about topic weighing and measuring. After that, they can linking idea and identifying symbol, icon, picture, concept in pictorial maps by using tools for weighting and measuring in mathematics subject. It is illustrated the relationships between underline theories as follows: Ausubel's theory of graphic organizer, Piaget's theory of cognition development, Bruner's discovery learning theory, Sternberg's triarchic theory of intelligence. This phase is the stage scope usage instrument and selective perception.

Phase 5 analyze and correct answer by using interactive pictorial map: students analyze logic, interactive pictorial and write the answer or select the pictorial (illustration). The correct answer is an illustration; students can applying, specifying and generalizing

(generalization) to explain their analytical thinking.

It is illustrated the relationship between underline theories as follows: Bloom's Taxonomy of Education Objective, Marzano and Kendall's New Taxonomy of Education Objective and Anderson and Krathwohl's A revision of Bloom's Taxonomy, Polya's problem, Gagne's theory of instructional design, 5E's of inquiry approach, Ausubel's theory of graphic organizer, Piaget's theory of cognition development, Bruner's discovery learning theory, Sternberg's triarchic theory of intelligence. This phase is the stage scope explanation results.

The result of the analysis of indicators relate to element of interactive pictorial maps perform by expert teachers in education technology, psychology and educational measurement and evaluation found that the index of consistency is 1.00, which passed the standard for every indicator ($IOC > 0.5$ sets the standard). An evaluation of essentials of mathematics learning of Prathomsuksa 2 students investigate by experts found that the indicators of ability such as 1) Learning tools: introduction course, terms of using tools, exploration pictorial maps are consistent and proper to student learning. 2) Problem analysis: question, pictures, symbolic are consistent and proper to problem analysis in student learning. 3) Classification and relationships: the pictorial size, pictorial

color, the pictorial site in question and answer show classify of the relationship are consistent and proper to student learning. 4) Linking ideas by using interactive pictorial maps: explore interactive pictorial maps to find the link points to analyze information, show traces linked to the idea of analytical thinking are consistent and proper to student learning. 5) Analyze and the correct answers by using interactive pictorial maps: show answer of matching, classifying, analyzing error, organizing, attributing, applying, specifying and generalizing are consistent and proper to problem analysis in student learning.

DISCUSSIONS

The framework of this study in documentaries will propose the stage of Interactive pictorial maps. The elements of stage will make sure support student learning based on the theoretical framework. The study focuses designing framework of interactive pictorial maps to promote analytical framework. The stage of designing framework involved several steps including a learning tools about weighing and measuring, problem analysis, classification and relationship, linking ideas by using interactive pictorial map, analyze and correct answer by using interactive pictorial map.

The designing tools is a very important support learning activity, instructional design, student performance evaluation. In the

step of designing framework, researcher study the details and lead to learning helps students to think analytically. One of designing, this reflect the concrete of learning that help students linking their ideas lead to analytical thinking. The concrete learning, needs to use pictorial (tools) as an icon or symbol picture. This design consistent with the concrete learning. According to Kunnath, Cornell, Kysilka and Witta, (2007) have shown that the representation about pictorial icon can use in the designing tools for teacher, instructional system, training and performance support, business and industry, health and medicine. These tools such as CD, web-based interactive instructional materials in education. Sung and Hu (2006) have expressed that the need for repeated pictorial understanding can eliminate by using logical picture. The designing concept thinking for student learning by using interactive pictorial maps, needs to know about graphic organizer. Castelyn and Mottart (2012) suggested that the using graphic organizer is a window of opportunity to renew the attention in the concept maps, mind mapping and non-linguistic representation (graphic organizers) though not often executed in a classroom. These could be the choice to direct ordering in most performances.

In learning by using tools relate the concepts to solving problem in mathematics topic on weighing and measuring. Gentner and Ratterman (as cited in Uttal, Scudder and

Deloache, 1997) have found that students need to perceive and understand relations between the manipulatives and other pattern of mathematics presentation. This is learning mathematics from manipulative. In mathematic learning, student can solve the problem by logic. Yaman (as cited in Sezen and Bulbul, 2011) revealed that an individual's ability to solve a problem by using mental operations; the ability to get principles or rules by making confident generalization or concept is logical thinking ability. The thinking with logic relevant with analytical thinking. Arnold and Wade (2015) have concluded that analytical skill include execution of ability to apply logical thinking to gathering and analyzing information, planning formulation, designing and testing clarifications to problems. This skill make concepts and decisions based on accessible information and provide the ability to solve problem with easy to complex, visualize, articulate that are sensible.

CONCLUSION

The study of education theories and databases that make it easy to analyze student's characteristic, student's analytical thinking, subject content matching the curriculum, and problem solving about mathematical analysis and lead to designing the stage of interactive pictorial maps (Tools), teaching and learning management that are aligned with the learning activities.

The theoretical framework consists of 4 foundations: 1) Graphic design and designing tools for learning, 2) Psychological base, 3) Analytical thinking base, 4) Mathematics base topic on weighing and measuring. The designing framework of interactive pictorial maps to promote analytical thinking topic on weighing and measuring comprises of 5 components as follows: 1) learning tools about weighing and measuring, 2) problem analysis, 3) classification and relationships, 4) linking ideas by using interactive pictorial maps, 5) analyze and the correct answers by using interactive pictorial maps.

Further research this study should be applied on the student attending and follow up the learning management, learning activities, student's perception for designing and developing materials and tools in the classroom.

ACKNOWLEDGEMENT

The researcher would like to acknowledge the support of Assoc. Prof. Jariya Neanchaleay, Asst. Prof. Dr. Surapon Boonlue and Dr. Peangpen Jirachai, Department of Education Communication and Technology, Faculty of Industrial Education and Technology, King Mongkut's University of Technology Thonburi, Thailand

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