

## **MatriksMovie: Building The Nation Character Through Movie-Based Realistic Mathematics Education**

**Adi Nur Cahyono**

*Department of Mathematics, Semarang State University, Indonesia*

*Email: adinegara@staff.unnes.ac.id, Homepage: <http://blog.unnes.ac.id/adinegara>*

### **Abstract**

The root of RME is Hans Freudenthal's interpretations, mathematics as human activity and mathematics must be connected to reality. This study developed a mathematics teaching and learning model that includes the characteristics of RME packaged in production and utilization of educational films in the learning process, it is called MATRiKSMovie Activity. Activity theory is based on Vygotsky's cultural-historical psychology and it focuses on understanding human activity and work practices. Practice of problem solving in real life can lead students to reflect, and build nation character. This research question are how to develop and implement a valid, practical and effective model of teaching and learning with movie based RME approach in Senior High Schools and its effect on students character and learning outcomes. Conclusion of this research are model of teaching and learning with movie based RME approach met the criteria of the content and construct validity, practicality, and effectiveness as it resulted in some positive impacts on the pupils at Grade 10 in Senior High Schools, mathematics learning with movie-based RME approach can serve to build student character as well as the civilization of the nation's dignity in order to educate the nation life, activities and process skills of students in mathematics learning with movie based RME approach has provided a positive impacts on the student learning outcomes (cognitive, affective, and psychomotor). Model of teaching and learning with Movie-based RME approach can be applied in learning mathematics and should be developed further by taking into account students' environment, conditions and facilities available. Humanistic mathematics learning should be developed to build the nation character.

**Keywords:** MATRiKSMovie, Realistic Mathematics Education, Movie, the Nation Character

### **I. INTRODUCTION**

Realistic Mathematics Education (RME) refers to the approach to mathematics education that has been developed and applied in Netherlands since 1971. RME is rooted in the interpretation of Hans Freudenthal, namely mathematics as human activity and mathematics must be connected to reality. Mathematics should be undertaken as an activity in which students experience mathematics as a meaningful subject and can better understand it (Freudenthal, 1991). De Lange says that the process of developing mathematical concepts and ideas starts from the real word, and at the end we need to reflect the solution back to the real world. So, what we do in mathematics education is to take things from the real world, mathematizing them, and then bring them back to the

real world. All this process lead to conceptual mathematization. Schematic model of learning is described as follow.

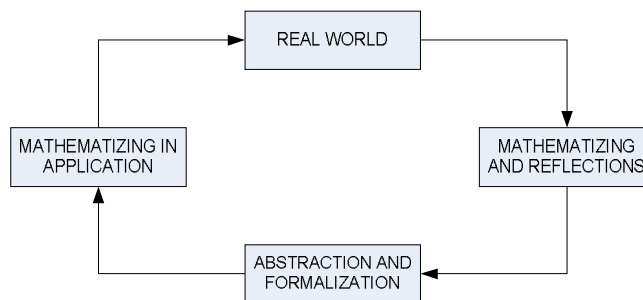


Figure 1. Conceptual Mathematization (de Lange, 1996)

Through a process of progressive mathematization, learners are given the opportunity to rediscover the insights, knowledge and mathematical procedures. Thus the learners do the stages in the RME is referred to as horizontal and vertical mathematization. Freudenthal (1991) makes the distinction between horizontal and vertical mathematization:

*Horizontal mathematization leads from the world of life to the world of symbols. In the world of life one lives, acts (and suffers); in other one symbols are shaped, reshaped, and manipulated, mechanically, comprehendingly, reflectingly: this is vertical mathematization. The world of life is what is experienced as reality (in the sense I used the word before), as is symbol world with regard to abstraction.*

Gravemeijer (1994: 90-91), suggests that there are three principles key in the RME, namely: guided reinvention/ progressive mathematizing, didactical phenomenology, and self-developed models. For the operationalization of the three main principles of RME, according Panhuizen (in Gravemeijer, 1994: 114-115), RME has five characteristics, namely: the use of context, the use of models, student contributions, interactivity, and intertwining. There are five steps in learning mathematics core activities realistic, namely: to understand the contextual issues, explain the contextual issues, resolve contextual problems, compare answers, and conclude.

Results of the research in the Netherlands showed that the RME has shown satisfactory results. In the Netherlands, there are positive results from the use of RME curriculum materials (Sembiring et al., 2008). The Third International Mathematics and Science Study (TIMSS) results showed that students in the Netherlands scored highly in mathematics (Mullis et al., 2000). Inspired by the philosophy of RME, one group, RME

---

has the potential to improve students' understanding of mathematics (Streefland, 1991). According to Fauzan (2002) The IRME (Indonesia Realistic Mathematics Education) curriculum met the criteria of the effectiveness as it resulted in some positive Impacts on the pupils at Grade 4 in Indonesian primary schools.

Implementation of RME in teaching and learning should be developed further by adjusting the technological developments and conditions in the field. Based on the theory of cognitive development, senior high school students have entered the stage of formal operations, but not a few students who still require visualization of the concepts that are abstract concepts and applications in the real world. Some children at this age also tend to be less motivated in carrying out learning activities in mathematics and more interested in the entertainment world because of the influence of age, social, environmental, facilities, and technology. The Phenomenon encourages innovation in implementing the steps of learning mathematics with the RME approach. Mathematics learning that includes the characteristics of RME packaged in production and utilization of educational films in the learning process, it is called MATRiKSMovie Activity. In these activities students demonstrate the process of solving problems related to the rediscovery of the mathematical concepts and applications of mathematical concepts in real life.

Activity theory is based on Vygotsky's cultural-historical psychology (Engeström, 1987) and it focuses on understanding human activity and work practices (Uden, 2007). The Activity Theory has also been applied to designing constructivist learning environments (Jonassen & Rohrer-Murphy, 1999). The central idea of the Activity Theory is that all human actions are called activities. An activity involves an object that is to be transferred to the output of the activity. In the Activity Theory, a subject performs an activity using a tool. The tool can be a physical tool or an abstract tool, such as computer software, and it mediates activity between the subject and the object. The interactions between subjects, object and community can all be mediated. Rules mediate the activity between the community and a subject. The activity may be collaborative, i.e. several subjects jointly do the activity using tools and dividing the work between each subject. The object can be, for example, a problem to be solved. In general, tools, rules and division of work mediate the relationship between the subject, community and object. Tools, rules and division of work are artefacts that are used to

achieve the outcome. Artefacts are not necessarily a fixed set of tools or things, but they can evolve over time (Kaptelinin & Nardi, 2006). Experiences and attitudes influence one another (Uden, 2007). Activity can furthermore be divided into actions and an action on operations. In general, activities are based on high-level goals (for example, documenting a work process with images and video clips). The Shared Activities and Experiences framework originates from a need to describe sharing and experiences in social media in theoretical terms (Multisilta, 2008).

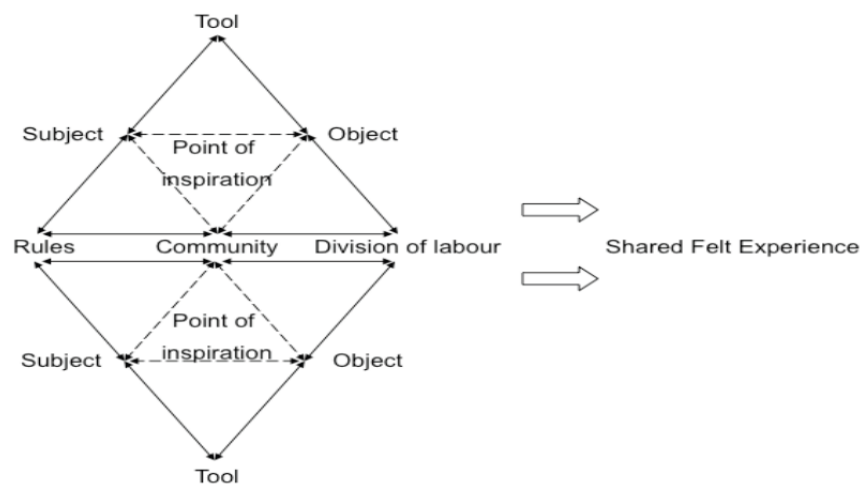


Figure 2. The Shared Experience and Activities Framework (Tuomi, P. & Multisilta, J., 2010)

Practice problem solving in real life can lead students to reflect, so that learning mathematics can instill motivation, appreciation, contribution, interest, beliefs, creativity, confidence and Perseverance and a sense of responsibility and communication skills. RME approach if done as a conscious and planned effort through habituation to the consistent, continuous and consequently believed to be able to grow and engrave independence, democracy, tolerance, humanism and honesty. Undang-Undang Republik Indonesia nomor 20 tahun 2003 about National Education System (UU Sisdiknas) defines the function and purpose of national education which should be used in developing educational efforts in Indonesia. In Pasal 3 UU Sisdiknas stated, "The function of National Education is to develop and build the character as well as the civilization of the nation's dignity in the framework of the intellectual life of the nation, aimed at developing the potential of learners in order to become a human who is faithful and pious to God Almighty, noble, healthy, knowledgeable, capable, creative, independent, and become citizens of a democratic and accountable". National education goals is the formulation of the Indonesia human qualities that should be developed by

---

each education unit. Therefore, formulation of national education goals is the basis for the development of culture and national character education.

From background of the problem, research questions arise: (1) How to develop and implement a valid, practical and effective model of teaching and learning with movie based RME approach in Senior High Schools? (2) How can mathematics learning with movie-based RME approach serve to build student character as well as the civilization of the nation's dignity in order to educate the nation life? (2) Are the activities and process skills of students in mathematics learning with movie based RME approach in Senior High School provide a positive impact on the student learning outcomes (cognitive, affective, and psychomotor)?

## II. RESEARCH METHOD

This study followed a development research approach by van den Akker & Plomp. According to van den Akker & Plomp (1993), development research is characterized by its two fold purpose: (1) development of prototypical products, including empirical evidence of their quality, (2) generating methodological directions for the design and evaluation of such products. The main aim of this study was to develop and implement a valid, practical and effective model of teaching with MATRiKSMovie Activity for teaching and learning in Senior High Schools.

According to Cahyono (2006), model is defined as a conceptual framework used as guidance to do certain activity. In the other definition, model is defined as imitation or metaphor which is formulized. Pouwer (1974: 243) explain about model as assumption like metaphor formulized explicitly containing unsures which depends each other. As a metaphor, model has never been seen as part of data represented. Model explains phenomena in a form which is not usual. Every model is needed to explain something more or different from data. This requirement is fulfilled by presenting data in forms of summary (type, diagram), configuration (structure), correlation (pattern), idealization and the combination of the four. Thus, model is metaphor which is solid and useful for the comparison of relation between the choosen data and the relation among the choosen unsures of a logical construction.

In this study, Validity, practicality and effectiveness criteria are defined as follows: validity refers to the extent that the design of the intervention should include "state of the art knowledge" (content validity) and the various components of the

---

intervention are consistently linked to each other (construct validity), practicality refers to the extent that users (teachers and pupils) and other experts consider the intervention as appealing and usable in normal conditions, effectiveness refers to the extent that the experiences and outcomes from the intervention are consistent with the intended aims.

Following the work of Nieveen (1997) and Ottevanger (2001), the development and research activities in this study were conducted in three stages. The first stage was called the front-end analysis, in which the current situation of mathematics instruction at Senior High School was analyzed. The second stage of the study was called the prototyping stage. This stage consisted of the development of prototype 1 and prototype 2 of the lesson kit and formative evaluation of each prototype. The third stage of the study was called the assessment stage. In this stage the final version of the teaching model was developed and implemented, followed by summative evaluation activity. Reflecting on the development methodology ended this stage of the study.

### **III. RESULT**

The first stage was called preliminary stage or front-end analysis, in which the current situation of mathematics education, especially the situation of instruction at senior high schools was analyzed. The analysis in this stage was used as the basis for the development of valid, practical, and effective learning models. Technological development encourages innovation in teaching and learning of mathematics by adjusting to conditions. Students tend to be less motivated in learning mathematics and the difficulties in understanding concepts, solving problems, and its application to real life. In the second phase (prototyping stage), researchers developed a realistic mathematical learning device is packed in educational film production activity in the learning process (called MATRiKSMovie Activity). The prototype developed is a lesson plan, teachers guide, student workbook, and the evaluation sheet.

Draft prototype validated to obtain a valid and can be tested on the third stage to determine the practicality and effectiveness. The third stage of the study was called the assessment stage. In this stage the final version of the prototypical product was developed and implemented, followed by summative evaluation activity. Reflecting on the development methodology ended this stage of the study. Activity MATRiKSMovie implemented in a Senior High School, SMA Ibu Kartini Semarang in the subject matter of trigonometry class X in 2006. The results of implementation show that the learning



of mathematics through MATRiKSMovie Activity showed good results in efforts to foster motivation, appreciation, contribution, interest, beliefs, creativity, confidence and perseverance and a sense of responsibility and communication skills.

Syntax of the learning of mathematics through MATRiKSMovie Activity: (1) Teachers provide instruction, convey learning goals, students in the class divides into groups, distribute the student activity sheet. (2) The teacher gives problems to be solved by the students, so students are able to construct the concept of matter being studied and/ or apply the concepts in real life. (3) Students discussing with his team to share tasks and create problem-solving scenarios in accordance with the creativity of each. (with teacher guidance). (4) Accordance with their respective duties, students carry out a simple short film production process of solving the problem (the construction of concepts and/ or application of concepts). (5) Each production team presented the results of the production in the classroom using the medium of television. (6) Students discuss their work together with the guidance of teachers in the classroom. (7) Each student gives a conclusion. (8) Teachers give clear, straighten the concept (if there is a less precise), and give final task of learning (projects, pop quizzes and/ or homework). (9) Film products used for learning at home for students or used in the subsequent or next learning process.

Activities and process skills of students in this learning is making a positive impact on student learning outcomes. The learning outcomes in this study referred to three aspects: cognitive, affective, and psychomotor. The cognitive aspect included pupils' achievement and reasoning, the affective aspect involved pupils' motivation, activity, and creativity, while the psychomotor included skills in problem-solving process.





Figure 3. Practice problem solving in the real world, film production, and presentation or show the results in the classroom

#### IV. DISCUSSION

The results of the analysis indicate that some of the high school students still require visualization of abstract concepts and application of concepts in the real world. One material that is considered difficult by students is a matter of trigonometry. Student difficulties understanding the concepts and solving problems related to trigonometry, including equations and trigonometric functions and applications of trigonometry in real life. Students at this age also tend to be less motivated in carrying out learning activities in mathematics and more interested in the entertainment world because of the influence of age, social, environmental, facilities, and technology. Technological development encourages innovation in teaching and learning of mathematics by adjusting to conditions.

The results of the analysis is used as the basis for the development of models of learning with RME approach and packaged in educational film production activities in the learning process (called MATRiKSMovie Activity). The prototype developed is a lesson plan, teachers guide, student workbook, and the evaluation sheet. Activities of students in these activities is to demonstrate the process of solving problems related to the rediscovery of the mathematical concepts and applications of mathematical concepts in real life. Process in the production of educational films starting from a given theme as a problem (in the form of the rediscovery of the concept of mathematics, or mathematical applications), then the students discuss in a production team to develop problem-solving scenarios to be presented in the drama of human activity in problem solving, setting up properties which is needed in problem solving and presentation, to



---

present the steps solving the problem by acting in front of the camera (as actrist or as a presenter), the product is presented in real video and/ or graphic animation according to student creativity and made simple with simple tools, so implementation of these activities in accordance with the allocation of time that has been planned in the lesson plan. The results of this learning process are students and teacher portfolios and video learning. Video lesson can be used in the learning process in the next lesson.

Draft (which was designed in the prototype phase) validated in order to obtain a vaild prototype and are ready to be tested to determine the practicality and effectiveness of implementation. According to Vygotsky (in Cahyono, 2010), there are two important concepts in the sociocultural theory, the Zone of Proximal Development (ZPD) and scaffolding. Scaffolding for students to reach the ZPD occurs when students interact with each other in processing of film production. Besides to improving students' understanding in mathematics lessons, learning mathematics through MATRiKSMovie activity accordance with the functions and goals of national education which is formulated in UU Sisdiknas.

Formulation of the problem in these studies did not mention the nation character, but indirectly the national education goals stated in this study is the formulation of the human qualities of Indonesia should be developed by each education unit and the basis for the development of culture and nation character education. In these activities, students are trained to be creative and caring in solving problems, both social and environmental problems. Students work together in solving problem. Students are able to communicate their ideas and dare to be responsible. This learning can build motivation, appreciation, contribution, interest, beliefs, creativity, confidence and perseverance and a sense of responsibility and communication skills. RME approach can build self-reliance, democracy, tolerance, humanism and honesty. Mathematical learning occurs during the film production process and the film can be used as a medium of mathematics learning in the classroom in the next lessons. Activities and process skills of students in mathematics learning through MATRiKSMovie activity in the high school has provided a positive influence on the

---

results student learning (cognitive, affective, and psychomotor).

## V. CONCLUSION AND SUGGESTION

Based on the results from the three stages of this study, it has been concluded that: (1) model of teaching with movie-based RME approach (MATRiKMovie Activity) met the criteria of the content and construct validity, practicality, and effectiveness as it resulted in some positive impacts on the pupils at Grade 10 in Senior High Schools, (2) mathematics learning with movie-based RME approach can serve to build student character as well as the civilization of the nation's dignity in order to educate the nation life, (3) activities and process skills of the senior high school students in mathematics learning with movie-based RME approach (MATRiKMovie Activity) has provided a positive impacts on the student learning outcomes (cognitive, affective, and psychomotor).

Based on the conclusions of this study, it can be suggested that model of teaching and learning with movie-based RME approach can be applied in learning mathematics and should be developed further by taking into account students' environment, conditions and facilities available. Humanistic mathematics learning should be developed to build the nation character.

## VI. BIBLIOGRAPHY

- Cahyono, A.N. (2010). *Vygotskian Perspective: Scaffolding to Reach Students Zona of Proximal Development (ZPD) in Mathematics Learning*. National Seminar of Mathematics and Mathematics Education Proceedings, Mathematics Education Department UNY, ISBN: 978-979-16353-5-6 (442-448).
- Cahyono, A.N. (2006). *Development of Technology-based Creative Problem Solving in Mathematics Learning of Senior High School*. Magister Thesis. Semarang: Semarang State University.
- de Lange, J. (1996). *Using and applying mathematics in education*. In A.J. Bishop et al. (Eds.), *International Handbook of Mathematics Education*, 49 – 97. The Netherlands: Kluwer Academic Publishers.
- Engeström, Y. (1987). *Learning by expanding: An activity-theoretical approach to developmental research*. Helsinki: Orienta-Konsultit.
- Fauzan. (2002). Applying Realistic Mathematics Education (RME) in Teaching

- 
- Geometry In Indonesian Primary Schools. Doctoral dissertation. The Netherlands, Enschede: University of Twente.
- Freudenthal, H. (1991). *Revisiting mathematics education*. The Netherlands, Dordrecht: Kluwer Academic.
- Gravemeijer, K.P.E. (1994). *Developing realistic mathematics education*. The Netherlands, Utrecht: Freudenthal Institute.
- Jonassen, D. H., & Rohrer-Murphy, L. (1999). *Activity theory as a framework for designing constructivist learning environments*. Educational Technology Research and Development, 47(1), 61-79.
- Kaptelinin V., & Nardi B. A. (2006). *Acting with technology: Activity theory and interaction design*. Cambridge: MIT Press.
- Mullis, I., Martin, M., Gonzales, E., Gregory, K., Garden, R., O'Connor, K., et al. (2000). *TIMSS 1999: International Mathematics Report*. International Study Center, Lynch School of Education: Boston.
- Multisilta, J. (2008). *Designing for mobile social media*. In A. Karahasanovic & A. Følstad (Eds.), *Proceedings of The NordiCHI'08 Workshops New Approaches to Requirements Elicitation & How Can HCI Improve Social Media Development?* (pp. 72-79). Tapir, Trondheim.
- Nieveen, N.M. (1997). *Computer support for curriculum developer: A study on the potential of computer support in the domain of formative curriculum evaluation*. Doctoral dissertation. The Netherlands, Enschede: University of Twente.
- Ottevanger, W. (2001). *Teacher Support Materials as a Catalyst for Science Curriculum Implementation in Namibia*. Doctoral dissertation. The Netherlands, Enschede: University of Twente.
- Pouwer, J. (1974). *The Structural Confdigurational Approach a Methodological Outline on The Unconscious in Culture*. New York: Dutton & Co.
- Sembiring R.K., Hadi, S., & Dolk, M. (2008). *Reforming mathematics learning in Indonesian classrooms through RME*. ZDM Mathematics Education (2008) 40:927–939
- Streefland, L. (1991). *Realistic Mathematics Education in Primary Schools*. Utrecht: Freudenthal Institute.
- Tuomi, P., & Multisilta, J. (2010). *MoViE: Experiences and attitudes—Learning with a mobile social video application*. Digital Culture & Education, 2:2, 165-189.
- Uden, L. (2007). *Activity theory for designing mobile learning*. International Journal of Mobile Learning and Organisation, 1(1), 81–102.
-

---

Undang-Undang Republik Indonesia nomor 20 tahun 2003 about National Education System (UU Sisdiknas).

van den Akker, J. & Plomp, Tj. (1993). *Developmental research in curriculum: Propositions and experiences*. Paper presented at the annual meeting of the American Educational Research Association (AERA), Atlanta, April 12-16.