Profile of students mathematic connection ability managed in vocational high school

F N Fatimah¹*, Riyadi¹ and D R Sari²

¹Departement of Mathematics Education, Universitas Sebelas Maret, Surakarta, Indonesia
²Departement of Mathematics, Universitas Sebelas Maret, Surakarta, Indonesia

*Corresponding author: Nf.frida@gmail.com

Abstract. Mathematic connection is part mathematic thinking competence meant as the interrelationship of mathematic concept internally. The study aimed to investigate the students’ profile of managed mathematic connection in SMK Pelayaran. The study was qualitative with test method. The subject of the study was ten class year student consisting of three persons having different mathematic connection competence in SMK Pelayaran. The result of the study that students having high managed mathematic connection competence had characteristics of: 1) Able to identify problem other to mathematic concept, 2) able to identify concepts mathematic, 3) able to apply mathematic outside of mathematic context, 4) Able to determine basic mathematic to solve the problems, 5) able to understand mathematic concept was interrelated. Students with managed mathematic concept competence had characteristics of: 1) able to identify in other to mathematic, 2) able to identify concepts in mathematics, 3) able to apply mathematic outside mathematics context, 4) Able determine mathematic concepts. Low competence of mathematic connection students had characteristics: 1) not able to identify in other to mathematic, 2) unable to identify concepts in mathematics, 3) less ability in applying mathematic outside mathematics context. 4) Unable determine mathematic concept.

1. Introduction
Preschool students (Prekindergarten) to twelve year learn mathematic observing and understanding various mathematic themes interrelated each other, mathematic theme with other knowledge. Mathematic is a structured and interrelated science among themes. Preschool students (Prekindergarten) to twelve year learn mathematic observing and understanding various mathematic themes interrelated each other, mathematic theme with other knowledge. Mathematic is a structured and interrelated science among themes [1]. One theme is possibly a basic requirement of other themes, or such concept is needed to explain other concept. It is interrelated science, therefore, in solving a mathematic problem student must have good mathematic connection competence. Mathematics teacher has important role in learning to achieve mathematic learning objective, such as preparing and planning learning which is suitable with students’ condition to achieve learning objective. Mathematics is a dynamic science and mathematical knowledge develops as humans always strive to do continuous research of new problems existing in life has influenced her beliefs in teaching mathematics and learning mathematics.[2]. In learning mathematic, mathematic connection competence has important role. According to Mousley Establishing connection capabilities Mathematics is a form of activity Understanding Mathematics in Learning Teachers and students must do [3].
That in mathematic learning the interrelationship among concepts is very important because students can understand mathematic in whole and deeply. Besides that, students less memorize meaning that learning mathematic is easier. In case of students is being able to observe the concept interrelationship, principle or procedures correctly, and to give argument to explain it, they get deeper understanding and improve their self confidence. It is, therefore, through this type of process that occurs in the social interaction in the classroom that we defend the use of investigative practices, materialized in thematic problematizations, and composed of a set of open questions to be investigated as a methodological perspective of teaching and learning that introduces in Mathematics classes the principles defended [4].

The first is recognizing and applying mathematics to contexts outside of mathematics (the links between mathematics, other disciplines or the real world). Educational research in mathematics shows that these two phases of mathematical inquiry can be treated in a connected manner [5]. Organizations in mathematics linking the various elements contained therein. The elements in mathematics may consist of: Algebra, Geometry, Arithmetic, Probability, and Calculus. In addition, the mathematics may also consist of facts, concepts, principles, and skills. As the link between the concept of a square with a parallelogram. The square is a parallelogram that all sides are equal in length and all the right-angled corners. According to NCTM the mathematical connection is divided into three classifications: 1. The connections between topics, and mathematical processes, 2. Connections between mathematics with other sciences, and 3. Connections between mathematical concepts to everyday life. Mathematical connections ability required students in studying several mathematical topics that are interconnected with each other. If a topic is given individually then the lesson will lose a moment that is very valuable in an effort to improve student's mathematics achievement generally. Without a mathematical connection ability students will have difficulty learning mathematics. Considering the contributions of Anthropology to Education as a contribution to teacher training, our primary purpose is to start from the idea of culture as a concept that is transversal to the different areas of knowledge and as an important concept notion in the integral formation of any professional in the Educational field, with the perspective of establishing better relationships between teachers and future teachers with their students, so as to promote possibilities for them to relate better to the diversity of expressions in the classroom everyday [6].

Ulep et al. [8] describes mathematic connection indicators as follow: a. solving problem using graph, numeric count, algebra, and verbal representation, b. applying concepts and procedures got in new situation, c. realizing the relation among topics in mathematics, d. expanding mathematic ideas. Coxford [9] expresses that mathematic connection competence includes: connect conceptual and procedure; knowledge, using mathematic on other curriculum areas, using mathematic in life activity, observing mathematic as an integrated unity, implementing mathematic thinking competence and creating model to solve problem of other subject, such as music, art, psychology, science, and business, knowing connection among topics in mathematics and identifying various representation for similar concepts, Mathematical connection can also help and support students in learning mathematics. Moreover, this finding is also supported which found that there was a significant positive correlation between the achievement in math and the attitudes of the students. Be that as it may, there was no unique distinction in the frames of mind of the respondents towards science dependent on sexual orientation [10].

Jihad [11] states indicators of mathematic connection competence as follow: a. searching relation of various representation of concepts and procedures, b. understanding relation among mathematic topics, c. using mathematic in other subjects or in daily life, d. understanding representation equivalence of the same concept, e. searching connection of a procedure to another in equivalent representation, f. using connection among topics in mathematics, between topic in mathematic with other topic.

1.1. Aspect of using interrelation among mathematic ideas

It means using interrelation among ideas in mathematic which is able to relate mathematic concept either in a material or in different material. The competence can be seen based on the students’ ability and competence in: using relation of fact, concept, mathematic principle on going to solve problem,
identifying relation among principles of mathematic to solve problem, using relation of mathematic principles to find new principle or formula needed to answer the question.

1.2. Aspect of applying mathematic ideas outside mathematic context
Applying mathematic ideas outside mathematic context means using mathematic concept to solve mathematic problem in other disciplinary subject or in daily life (real life). The competence is seen based on the students’ ability in: identifying fact, concept, and mathematic principle outside mathematic context, using the relation of concept to procedure and counting process to solve the problem outside mathematic.

The description of indicator observed in each aspect of mathematic connection is shown in the following table.

| Aspect of mathematic connection | Technical Indicator |
|---------------------------------|---------------------|
| 1. Using the relation among ideas in mathematic | 1.1 using relation among fact, concept, and mathematic principle in the problem being solved |
|                                  | 1.2 determining the relation between a mathematic principle to another to solve problem |
|                                  | 1.3 Using the relation of a mathematic principle to another to get new principle or formula to solve the problem. |
| 2. Applying mathematic ideas outside mathematic context | 2.1 Identifying fact, concept, and mathematic principle outside mathematic context |
|                                  | 2.2 Using the relation of concept to procedure and counting process to solve outside mathematic problem |

2. Methods
It is a qualitative research using case study strategy aiming to find profile of mathematic connection competence based on the development of new curriculum requiring students to have connection in learning in order that the material learnt is understood well and easy to memorize.

2.1. Participant
The subject of the study were three students using different managed mathematic connection competence in SMK Pelayaran Pancasila Kartasura. Sampling of the study used purposive sampling technique. Researchers took three students having different level of managed self-learning. They were managed students of high, medium and low level of mathematic connection competence. They had good communication attitude.

2.2. Collecting data
The data were collected directly to the research subjects. Creswell explains that research to obtain pure results from students conducted through direct observation [12] During the student teaching experience, candidates are expected to provide evidences in writing lesson reflections demonstrating their ability to teach with technology and complete their work [13]. We examine the inductive reasoning of middle school teachers when generalizing. Clarifying what inductive processes teachers use and how they connect these processes to obtain generalizations would allow teachers and researchers to generate strategies to identify and improve them [14]. Data were collected in the study by questionnaire. Students’ learning managed connection indicator were:
Table 2. Mathematic connection indicator

| No | Indicator |
|----|-----------|
| 1  | Searching and understanding relation of various concept and procedure representation |
| 2  | Using mathematic in other disciplinary subject or daily life |
| 3  | Understanding equivalent same concept or procedure representation |
| 4  | Searching connection of a procedure to another in equivalent representation |
| 5  | Using connection among mathematic topics and between a mathematic topic to another |

2.3. Data analysis

The data were analyzed by describing or elaborating data collected through questionnaire. The researcher uses triangulation method to get valid data of questionnaire and Methods used in data collection are (1) Documentation method, according to [15] Documentation method for collecting data obtained from documents or note.

3. Results and Discussion

3.1. Subjects with high managed mathematical connections

Based on data analysis, it indicates that the subject has a high managed mathematical connection categor Teachers can interpret students' mathematical thinking by identifying strategies that students might use in solving a problem. Teachers can also identify why certain problems become difficult and cause problems considering the characteristics of students' thinking [16]. He has good competence in learning, such as (1) seeking and understanding the interconnectedness of various concepts and procedures of representation, (2) using mathematically in subjects of other disciplines or daily life, (3) Understanding the same concept or Representation of the same procedure, (4) Looking for connections from other procedures in the equivalent representation, (5) using the connection between mathematical topics and among other mathematical topics in determining mathematical problems or questions or disciplinary subjects Other related mathematical concepts, able to identify the relationship between concept or idea mathematically, applying mathematics outside the mathematical context (daily life problem), determining mathematical concepts underlying the procedure Problem solving, understanding how the mathematical concepts are interconnected by linking one topic to another. Subjects have high managed connection competencies that have a target of achieving learning duration and what they will get according to their target. It motivates them to get the best out of their efforts. There are different arguments among students’ high managed connection competencies.

3.2. Subjects with medium-run mathematical connections

Similarly, also found that beginner teachers have difficulties in interpreting students’ mathematical thinking and appropriate learning approaches. Due to their lack of teaching experiences, prospective teachers have limited knowledge and experiences about the various strategies of students in solving the problem [17]. From data analysis, it shows that the subject with a Medium-run mathematical Connection he can (1) lack ability to find and understand the interconnectedness of various concepts and procedures of representation, (2) using mathematically in the subject Other disciplines or daily life, (3) lacking its ability to understand the same concept or representation of the same procedure, (4) Looking for connections from other procedures in an equivalent representation, (5) using the connection between mathematical topics and between Other mathematical topics can choose the learning strategy used in performing the task, able to relate to other topics, learn by using more than one reference, find the relationship between mathematical principles and other to Solve problems, using the relationship between facts, concepts, and mathematical principles on the problem will solve. The relevance of this relationship can be seen that a suitable approach to be applied in mathematics teaching is those which is student-centered where learning begins with giving the students problems helping students understand problems, discussing and finding solutions [18]
3.3. Subjects with low controlled mathematical connections

Based on data analysis, the results of this study indicate that prospective teachers have similar interpretative characteristics. Interpreting students’ mathematical thinking are key teaching tasks in which teachers must generate hypotheses about how students’ mathematical thinking could be developed [19] the subject with a low controlled mathematical connection he can (1) his capacity is lacking in finding and understanding the interconnectedness of various concepts and procedures of representation, (2) less ability to use mathematically in the subject Other disciplines or daily life, (3) its ability is lacking in understanding the same concept or representation of the same procedure, (4) Looking for connections from other procedures in the equivalent representation, (5) its ability to use the connection between Mathematical topics and among the mathematical topics that other study strategies used to study and unable to relate to other topics, using more than one reference, could not find another mathematical principle relationship to Solve the problem, can not use the relationship between facts, concepts, and mathematical principles on the problem will solve, always gets a bad score, but it does not change their learning habits. Knowledge of mathematics refers to the knowledge and skill of mathematics, which is exclusively used in the teaching practice, such as conceptual knowledge and procedural of the topic of mathematics.[20] They never follow their score. For them, learning activities never demanded them to change their lives.

4. Conclusion

Mathematic connection competence is ability to find the relation among mathematic principles to solve problem. Therefore, students can use their mathematic connection competence. The mathematic connection competence includes: connecting conceptual and procedural knowledge, using mathematic on other topic, using mathematic in life activity, seeing mathematic as integrated subject, applying mathematic thinking and creating model to solve problem of mathematic connection which would be fact when they cannot use their competence to relate the topics.

Profile of mathematic connection in SMK Pancasila Pelayaran is as follow.

- Students with high managed mathematic connection have characteristic of being able to determine problem in other disciplinary subject related to mathematic concept, able to identify relation among concepts or ideas in mathematics, able to apply mathematic outside mathematic context (daily life), able to determine mathematic concept underlying procedure of solving problem, able to understand interrelated concept of mathematic.

- Students with medium managed mathematic connection have characteristic of being able to determine problem in other disciplinary subject related to mathematic concept, able to identify relation among concepts or ideas in mathematics, able to apply mathematic outside mathematic context (daily life), able to determine mathematic concept underlying procedure of solving problem.

- Students with low managed mathematic connection have characteristic of being not able to determine problem in other disciplinary subject related to mathematic concept, not able to identify the relation among concepts or ideas in mathematics, lack competence in applying mathematic outside mathematic context (daily life), not able to determine mathematic underlying problem solving procedure.
Acknowledgments
The authors would like to thank to the adviser Dr. Riyadi M.Si dan Dr Dewi Retno Sari Saputro, S.Si, M.Kom, my parents, my little brother and all friends of PPS UNS 2016 generation.

References
[1] Akgunduz D 2016 Eurasia J. Math. Sci. Technol. Educ. 12 1365
[2] Viholainen A, Asikainen M and Hirvonen P E 2014 Eurasia J. Math. Sci. Technol. Educ. 10(2) 159
[3] Mousley J 2014 Int. Group Psychol. Math. Educ. 3(1) 377
[4] Moles A A 2012 Sociodinâmica da cultura [Sociodynamics of culture] (São Paulo: Perspectiva)
[5] Hanna G and De Villiers M 2012 Proof and proving in mathematics education: The 19th ICMI study (New York: Springer)
[6] Mendes I A 2013 RIPEM 3 40
[7] Swartz R 2012 Sri Lanka J. Educ. Res. 3 1
[8] Ulep S A 2000 High School Mathematics I & II, Sourcebook on Practical Work for Teacher Trainers (Quezon City: SMEMDP)
[9] Karj N 2017 Int. J. Math. Educ. Sci. Technol. 48(6) 849.
[10] Hersant M and Orange-Ravachol D 2012 Proceedings of the Conference EMF p 1378
[11] Danielson C 2013 The Framework for Teaching Evaluation Instrument (Virginia: Association for Supervision and Curriculum Development).
[12] Abu-Elwan R 2019 Int. Electron. J. Math. Educ. 14 467
[13] Mendes I A 2019 Int. Electron. J. Math. Educ. 14 501
[14] Moguel L E S, Landa E A and Cabañas-Sánchez G 2019 Int. Electron. J. Math. Educ. 14 563
[15] Queirós A, Faria D and Almeida F 2017 Eur. J. Educ. Stud. 3 369
[16] Widodo S A, Istiqomah, Leonard, Nayazik A and Prahmana R C I 2019 J. Phys.: Conf. Ser. 1188(1) 012087.
[17] Sleep L and Boerst T A 2012 Teach. Teach. Educ. 28(7) 1038
[18] Felibrich A, Kaiser G and Schmotz C 2014 J. Math. Educ. 10(2) 185
[19] Fernández C, Limares S and Valls J 2012 Int. J. Math. Educ. 44(6) 747
[20] Hawkins W J 2012 Proceedings of the 12th International Congress on Mathematical Education (Seoul: Seoul National University)