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Problem Solving Ability of Class VIII Students Viewed from Cognitive Style in Attention Relevance Confidence Satisfaction Model Assisted by Problem Cards

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Abstrak

This study aims to (1) find out the description of the quality of ARCS learning assisted by problem cards on mathematical problem solving abilities of students (2) obtain a profile description of students 'mathematical problem solving abilities with field dependent cognitive style (3) obtain a profile description of students' mathematical problem solving abilities with field independent cognitive style. This research is a mix method research with concurrent embedded design. The study population was VIII grade students of SMPN 22 Semarang. The research subjects were determined based on weak, moderate, strong field dependent categories and weak, moderate, strong field independent categories. Data collection techniques of this research were observations, tests, and interviews. The results of this study indicate that (1) ARCS learning assisted by problem cards is appropriate both quantitatively and qualitatively on students' problem solving ability (2) students with field dependent cognitive styles in solving mathematics problem are still globally and less detailed in writing information according to the questions, write the answers incorrectly, do not check the correctness of the work and do not compile the steps of solving problems in different ways (3) students with field independent cognitive style in solving mathematics problem are understand the problems more analytically and do not write the same thing contained in the question, simplify the problem using their own sentences, apply the planned problem solving steps and obtain the correct answer, check the correctness of the work but do not compose the problem solving steps in different ways.

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INTRODUCTION

According to Minister of Education No. 22 of 2006 concerning content standards (Ministry of National Education), mathematics subjects aiming for students to have the ability of 1) understanding mathematical concepts, explaining inter-concept linkages and applying concepts or algorithms flexibly, accurately, efficiently and precisely in problem solving 2) using reasoning on patterns and traits, making mathematical manipulations in making generalizations, compiling evidence or explaining mathematical ideas and statements 3) solving problems that include the ability to understand problems, designing mathematical models, completing models and interpreting solutions obtained 4) communicating ideas with symbols, tables, diagrams or other media to clarify the situation or problem 5) respecting the usefulness of mathematics in life, namely having curiosity, attention and interest in learning mathematics, and being tenacious and confident in problem solving.

Mathematics is very closely related to problem solving (Ulya, 2014). According to NCTM (2000) by learning problem solving in mathematics, students must learn ways of thinking, diligent habits, curiosity, and confidence in new situations that they will face beyond the school mathematics.

Based on observations in SMP Negeri 22 Semarang with 35 students observed, it indicated that the average of daily math test scores for geometry materials were 60 with KKM 75 . This shows that students problem solving ability was still low. During the learning process students seemed less motivated because the learning was less associated to their daily life. Students only memorized mathematical formulas without associating mathematical concepts that have been found, there were still many students who are sleepy, talked out of the topic and seemed bored when they were explained.

Efforts that can be done to improve the students' problem solving abilities are by implementing innovative learning models which can stimulate students' motivation to learn mathematics. According to Marlissa & Widjajanti (2015) the learning process is generally using the lecturing method to deliver material and more focused on memorizing formulas to solve math problems and emphasizing a knowledge transfer from teacher to student, therefore it is necessary to have any innovative learning models that can improve students' problem solving ability. One of the models which can be applied is the ARCS learning model (Attention, Relevance, Confidence, Satisfaction). This is in line with Keller (1987) that ARCS is a problem solving model. The first component of such model is attention. Attention is an element of motivation and is also a prerequisite for learning. The second component is relevance that is linking learning with their lives, the third component is confidence and the fourth is satisfaction (Keller, 1987; Farida, 2016).

An innovative and fun learning in the classroom can be done by utilizing some learning media. One of the learning medias which can be used is the problem cards. Such media contains some questions that must be done in groups and presented by students. According to Rahmawati (2013), due to the various types of questions on the problem cards, students are expected to be interested and active in finding solutions so that they can improve the students' problem solving ability.

Each individual in classroom learning has different characteristics. To find out the students' problem solving ability, it is necessary to pay attention to their individual differences. Lack of teacher's understanding about individual students' characteristics will cause a negative impact on learning outcomes. Each student has a different response in absorbing, organizing and processing the subject matter given by the teacher. A person's differences in preparing, processing information and experience are called the cognitive styles (Agoestanto *et al*, 2017). In addition, according to Brown *et al*. (2006) cognitive style is a psychological construction which is related to how individuals process any information. According to Umaru & Tukur (2013) several elements of cognitive styles focus on the field dependent or field independent individuals (Witkin and Goodenough, 1981); Global or analytical (Dwyer and Moore, 2001); concrete or abstract (Jonassen and

Grabowski, 1993), global or sequential (Summerville, 1999); risk-taking or cautions (Jonassen, 1988) and dependent or independent (Witkin *et al*, 1977, 1984). The field dependent and field independent cognitive styles have been studied deeply and have extensive applications in educational contexts. People who have a field independent cognitive style prefer to separate parts of some examples and to analyze examples based on components and objectives that can be achieved with their own strength (Agoestanto *et al*, 2017). Meanwhile, individuals who have a field dependent cognitive style tend to see the overall pattern without dividing into several patterns and rely on outside information to achieve goals (Agoestanto *et al*, 2017).

Based on the background above, the objectives of this study are (1) to describe the quality of ARCS learning assisted by problem cards on students' mathematical problem solving ability (2) to obtain the profile descriptions of mathematical problem solving ability of students with field dependent cognitive styles (3) to obtain the profile descriptions of mathematical problem solving ability of students with field independent cognitive styles.

METHODS

This research is a combination of qualitative and quantitative research (mix method). This research used the concurrent embedded design. According to Sugiyono (2016) concurrent embedded design is a research method which combines quantitative and qualitative research methods by mixing those two methods in an unbalanced manner. In this study qualitative is more emphasized and quantitative is used as the supporting data to analyze the results of the problem solving ability test that is associated with the cognitive style of students. Problem solving abilities that are associated with cognitive styles are analyzed quantitatively then described qualitatively.

The population of this study was the eighth grade students of SMPN 22 Semarang. From such population, 2 classes was chosen as samples. The experimental class was VIII C and the control class was VIII D. The subjects were 3 student selected from each category of cognitive styles. Data collection techniques consist of observation, tests, and interviews. The quantitative data analysis technique started from the analysis of the test items, the prerequisite test then the hypothesis test which included individual completeness tests, classical completeness tests, different proportional tests, and average difference tests. Qualitative data analysis techniques were done by qualitative descriptive methods that refer to the opinions of Miles and Huberman in Sugiyono (2016), namely data reduction, data presentation, and drawing conclusions or verifications.

RESULT AND DISCUSSION

The quality of learning includes (1) planning, (2) implementation, and (3) assessment. The planning phase includes the preparation of learning devices including syllabus, lesson plans, teaching materials, and initial tests of problem solving skills, final tests of problem solving skills, learning implementation sheets, and interview sheets. The validator assessment data are presented in Table 1 as follows.

Tabel 1. Results of Validator Assesment

Learning Devices	Validators		Mean	Category
	1	2		
Syllabus	3.57	3.71	3.64	Good
Lesson Plans	3.64	3.85	3.74	Good
Teaching Materials	3.85	3.57	3.71	Good
Initial tests of problem solving skills	3.7	3.7	3.7	Good
Final tests of problem solving skills	3.8	3.6	3.7	Good
Learning Implementation sheets	3.2	3.1	3.15	Good
Interview Sheets	3	3	3	Quite Good

Based on device validation data by experts, the average scores of syllabus, lesson plan, teaching

materials, initial test of problem solving ability, final test of problem solving ability, and learning implementation sheet are in good category, while the interview sheet is quite good, this is because the interview sheet is still use inappropriate sentences so it did not get a good score on the language indicator. Based on the results of the instrument validation shows that the instrument is worthy of being used for research.

The implementation phase can be measured from the learning implementation observation sheet. The learning implementation is said to be qualify if the results of observations on the quality of learning are at least included in the good category. The results showed that the average quality of learning implementation was at least included in good category, so it can be concluded that the researcher prepares and manages the learning well.

The preliminary normality data test showed that the data comes from a population that is normally distributed, while the homogeneity test also showed that the variance is homogeneous, the mean similarity test of the initial data shows that there is no average difference, the initial test similarity to the average test problem that there is no difference in the average of the two classes. Individual completeness test results showed t_{count}= 7.81> 1.69 = t_{table}, it means that the average problem solving ability of students in ARCS learning assisted by problem cards achieved completeness. The classical completeness test obtained z_{count}= 3.07 > 1.64 = z_{table}, it means that the proportion of students in ARCS learning assisted by problem cards that reached completion had exceeded 75%. In the different proportion test obtained z_{count}= 1.70 > 1.62 = z_{table}, it means the proportion of problem solving abilities of students in ARCS learning assisted by problem cards was more than the proportion of students' problem solving abilities in PBL learning. The mean difference test showed that t_{count}= 2.06 > 1.66 = t_{table}, it means that the average of problem solving ability of students using ARCS assisted by problem cards is better than the average problem solving ability of students in PBL learning.

This shows that learning using ARCS assisted by problem cards can be said to be having a good quality. ARCS learning begins with attention. How to focus the attention is by giving motivational words from world leaders of mathematics so students will be interested in the material. Students who are already motivated will enliven the classroom atmosphere to learn well. This is in line with the research of Zeyn et al (2017) that the ARCS learning model can maintain the students' motivation so that it is influential in reviving the atmosphere when participating in classroom learning. At the relevance stage, the material provided will be linked or related to their daily lives so that they will know the benefits and uses in their daily lives. This is in line with Rochaminah (2011) who stated that mathematics learning should be connected with concrete things and associated with the daily life. Furthermore, at the confidence stage students is organized into small groups to solve the problems given. Such step aims to build the interactions among the students, make the students dare to express their opinions when discussing so that later when presenting the results of the discussion in front of the class they already have a high self-confidence. The last stage is satisfaction. At this stage, the teacher provides confirmation and reinforcement of the results of student answers.

Learning with the ARCS model in this study is assisted by problem cards. The existence of the problem cards makes the teacher more efficient in using time because there is no need to write questions on the board. In addition, the problem cards are used during the discussion session that can increase the active role of students, students can work together to solve problems on the problem cards. This is in line with the opinion of Rahayu *et al* (2014) that learning using the ARIAS model assisted by problem cards, involves the active role of students to work together and actively speak up their opinions in front of the class.

Qualitative research was conducted to describe the ability of students to solve mathematical problems based on their cognitive style. The instrument used to clarify the cognitive style of students was the Group Embedded Figure Test (GEFT). After the test, 3 subjects were randomly selected in the FD and FI categories. FD subject analysis included weak FD (FDL) subjects, moderate FD subjects (FDS) and

strong FD subjects (FDK) while analysis on FI subjects included subjects of weak FI (FIL), medium FI (FIS) and strong FI (FIK).

The pattern of problem solving abilities in terms of the cognitive style of the FDL type is as follows. Based on the results of the study, students with the FDL cognitive style type were generally able to understand the problem. This can be seen from students being able to write things that are known and asked correctly. Students can also explain the problem description well, even though it requires a longer time to work. At the stage of devising a plan was included in the category good enough. In this case, the students are less able to simplify the problem. At the stage of carry out the plan, the category was not good. Students have difficulty in translating problems given into mathematical sentences. At the looking back stage, the category was not good. Students did not check the correctness of the results of the answers. In addition, students did not write the conclusions of the answers and students cannot arrange the steps of completion with different steps.

The pattern of problem solving abilities in terms of cognitive style type FDS is as follows. Based on the results of the study, in general students with the FDS cognitive style type were able to understand the problem. This is indicated by students being able to write down what is known and asked. Students can also sketch clear problems. At the stage of devising a plan included in the category enough. Students still have difficulty in simplifying problems. At the stage of carrying out the plan included in the less good category. Students have difficulty translating problems given in the form of mathematical sentences. At the looking back stage it falls into the bad category. Students do not check the truth of the results of their work, do not make conclusions about the solution to the problem, and do not arrange the steps of completion with different steps.

The pattern of problem solving ability in terms of the FDK cognitive style is as follows. Based on the results of the study, in general students with the FDK cognitive style type at the stage of understanding the problem were included in the good category. Students were able to write things that are known and asked. In addition, students were also able to explain the picture of the problem. At the stage of divising a plan FDK students were included in the good category. Students were able to develop problem solving plans based on the facts provided, knowledge of preconditions, and clear procedures. Students can also simplify the problem well. The next stage is carrying out the plan. In this indicator FDK students fell into the category of underprivileged. Students had difficulties in translating problems given into mathematical sentences. In addition, students were still wrong in using the formula to answer questions even though the problem solving plan is correct. The last step is looking back. At this stage FDK students fell into the unfavorable category. Students did not check the correctness of the answers, students cannot make conclusions on solutions, and students did not arrange steps for solving problems with different steps.

The pattern of problem solving abilities in terms of cognitive style type FIL is as follows. At the stage of understanding the problem was included in the good category. Students can write what they know and ask correctly. At the stage of devising a plan was included in the good category. Students were able to simplify problems, develop problem solving plans based on the facts provided with clear procedures. Furthermore, at the stage carrying out the plan is included in the unfavorable category. Students seemed to have difficulty in translating problems given into the form of mathematical sentences. In addition, the use of formulas to solve problems was also not right. In the next stage, which is looking back, it fell into the bad category. Students were not able to draw conclusions for solutions, arrange steps for completion with different steps, and students did not check the correctness of the answers at each step taken in solving the problem.

The pattern of problem solving ability in terms of cognitive style FIS type is as follows. At the stage of understanding the problem was included in the good category. Students were able to write what is known and asked in their own sentence. In addition, students were able to describe the information of the problem. At the stage of devising a plan was included in the good category. Students were able to develop a

problem solving plan based on the facts provided with clear steps. In addition students were also able to sort information which was then simplified to be able to estimate the strategies that will be used to solve the problem. At the stage of carrying out the plan, it was included in the good category. This is indicated by students being able to solve problems with a predetermined strategy and able to translate the problem given in the form of mathematical sentences. At the looking back stage it was included in the good category. Students can draw conclusions from solutions, and re-examine the results of their work but cannot arrange steps for completion with different steps.

The pattern of problem solving abilities in terms of the FIK type cognitive style is as follows. At the stage of understanding the problem was included in the good category. Students were able to write what is known and asked correctly using their own sentences. Students were also able to give a clear picture of the problem. At the stage of divising a plan was included in the good category. This is indicated by students being able to develop problem solving plans based on facts provided with clear procedures, able to simplify problems, and be able to sort information. At the stage of carrying out the plan was included in the good category. Students were able to translate the problem given in the form of mathematical sentences and solve problems with predetermined strategies. At the looking back stage it was included in the good category. FIK students were able to draw conclusions and check the correctness of the answers to their work but did not arrange the steps of completion with different steps.

Overall the FD students at the stage of understanding the problem were able to write down the things that were known and asked and were able to explain the problem description. But in understanding the problem FD students were still globaly and lacks detail in writing information on the questions. This is in line with the opinion of Armstrong et al (2011) that FD individuals adopt a global orientation to understand and process information. At the stage of divising a plan, FD students developed a general problem solving plan in accordance with the facts in the problem. This is in accordance with Witkin et al (1977) that FD individuals were less able to separate a part of a unit and receive a more dominant part. At the stage of carrying out the plan, FD students were less able to write the formula that will be used in solving the problem and in writing the answers were still not right. This was caused by FD students having difficulty manipulating the right algebraic forms to solve problems. This is in line with the opinion of Vendiagrys *et al* (2015) that FD individuals often cannot obtain the correct answers. At the looking back stage, FD students tend to be less capable. FD students did not write the conclusion of the answer, did not checked the truth of the work, and did not solve the problem with different steps. This is in line with Prabawa (2017) who said that FD subjects tend to be less able to looking back and write conclusions from their work.

Overall the FI students at the stage of understanding the problem were able to write down things that were known, asked questions, and explained the problem description in their own sentence. FI students were more analytical in understanding problems and not writing the same things contained in the questions. This is in line with the opinion of Guisande et al (2007) that FI individuals have no difficulty in separating information that is more important than context and more selective in processing information. At the stage of devising a plan, FI students were able to develop a problem solving plan based on the facts given and simplify the problem using their own sentences. This is in line with the opinion of Ebrahimi (2013) that FI individuals can divide sentences into words, memorize words, and then combined them again to make sentences. At the stage of carrying out the plan, FI students were able to apply the steps to solving the planned problem and obtain the correct answers. This is in accordance with Hassan (2002) that the way of thinking of FI individuals supports a higher appearance in solving mathematical problems compared to FD individuals. At the looking back stage, FI students tend to be less able to arrange different problem solving steps. But some FI subjects only wrote the conclusions of the answers and re-examined the correctness of the work. This is in line

with the opinion of Arifin (2018) that FI subjects can write conclusions of the answers correctly.

CONCLUSION

Based on the results and discussion above, the conclusions are as follows. The quality of ARCS learning assisted by problem cards on problem solving abilities is included in the good category. This is indicated by (1) at the preparation stage, the learning device used is valid, (2) at the implementation stage, the learning implementation carried out by the researcher belongs to the good category, (3) at the assessment stage, students' problem solving ability in the learning with ARCS models assisted by problem cards have achieved individual and classical completeness and problem solving abilities of students in ARCS learning assisted by problem cards better than students' problem solving abilities in PBL learning. Profile of problem solving abilities of students in terms of cognitive style are (1) students with field dependent cognitive style in solving mathematics problem that are still global and lack in detail in writing the information on the questions, in writing the answers are still incorrect, not checking the correctness of their work and does not make problem solving steps with different steps (2) profiles of students with field independent cognitive style in solving mathematics problem, which are more analytical in understanding problems and not writing the same things contained in the questions, simplifying problems using their own sentences, applying steps for solving problems that have been planned and obtaining the correct answers, checking the correctness of their work but not making steps to solve the problem with different ways. By knowing the cognitive style of students, teacher can design their learning that is appropriate to the circumstances of students. The existence of ARCS learning model assisted by problem cards can train students problem solving ability. Achievement of students' problem solving abilities is different. This needs to be further examined the reason of such differences by giving other similar questions or adding research subjects to each type of cognitive style.

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REFERENCES

Agoestanto, A., Sukestiyarno, Y.L., & Rochmad. 2016. "Analysis of Mathematics Critical Thinking Students in Junior High School Based on Cognitive Style". *Journal of Physics.*

Amstrong, S.J., E. Cools, & E.S. Smith. 2011. Role of Cognitive Styles in Business and Management: Reviewing 40 Years of Research. *International Journal of Managemnt Reviews*, 14(3): 238-262.

Arifin, S., Kartono., Hidayah, I. 2018. "The Analysis of Problem Solving Ability in Terms of Cognitive Style in Problem Based Learning Model with Diagnostic Assessment". *Unnes Journal of Mathematics Education Research.*

Brown, E., Brailsford, T., Fisher, T., Moore., & Ashman, H. 2006. "Reappraising Cognitive Styles in Adaptive Web Applications." *Proceedings of the 15th international conference.*

Depdiknas. 2006. Permendiknas Nomor 22 Tahun 2006 tentang Standar Isi Sekolah Menengah Atas. Jakarta: Depdiknas.

Ebrahimi, A., Zeynali, S., & Dodman, K. 2013. " The Effect of Field Dependence-Independence Cognitive Style on Deductive-Inductive Grammar Teaching". *International Journal of Academic research in progressive Education and development*.

Farida, A. 2016. "Penerapan Model Pembelajaran ARCS (Attention, Relevance, Confidence, Satisfaction) Pada Mata Kuliah Matematika Diskrit Di Program Studi Teknik Informatika Stmik Duta Bangsa". *Jurnal Sains Tech Politeknik Indonusa Surakarta.* 1(5): 38–47.

Guisande, M.A., Paramo, M.F., Tinajero, C., & Almeida, L.S. 2007. "Field Dependence-Independence (FDI) Cognitive Style: An Analysis Of Attentional Functioning".

Psichotema Universidad de Oveido. 19(4): 572-577.

Hassan, A. 2002. "Students' Cognitive Style and Mathematics Word Problem Solving". *Journal of the Korea Society of Mathematical Education Series Research in Mathematical Education*. 6 (2): 171–182.

Keller, J.M. 1987. "Development and Use of the ARCS Model of Motivational Design". *Journal of Instructional Development* 10(1932): 2–10.

Marlissa, I & Widjajanti, D. M. 2015. "Pengaruh Strategi REACT Ditinjau Dari Gaya Kognitif Terhadap Kemampuan Pemecahan Masalah, Prestasi Belajar Dan Apresiasi Siswa Terhadap Matematika". *Jurnal Riset Pendidikan Matematika*. 2(2): 186-196.

NCTM. 2000. *Principles and Standards for School Mathematics*. Reston.

Prabawa, E.A. 2017. "Analisis Kemampuan Pemecahan Masalah Ditinjau Dari Gaya Kognitif Siswa pada Model Project Based Learning Bernuansa Etnomatematika". *Unnes Journal of Mathematics Education Research*. 6(1): 120-129

Rahayu, E.A., Waluyo, S.B., Sugiman. 2014. "Keefektifan Model Arias Berbantuan Kartu Masalah Untuk Meningkatkan Kemampuan Komunikasi Matematis Siswa". *Jurnal Kreano*.

Rahmawati, N.T., Junaedi, I., Kurniasih, A.W. 2013. "Keefektifan Model Pembelajaran SSCS Berbantuan Kartu Masalah Terhadap Kemampuan Pemecahan Masalah Siswa." *Unnes Journal of Mathematics Education (UJME).* 2(3): 67–71.

Rochaminah, S. 2011. "Meningkatkan Kemampuan Berfikir Matematika Tingkat Tinggi Siswa Sekolah Menengah Pertama (SMP) melalui Model Pembelajaran Inovatif". *Jurnal Pendidikan, Kebudayaan dan Seni Kreatif*. 14(1): 99-112.

Sugiyono. (2016). Metode Penelitian Kombinasi (*Mixed Method*). Bandung: Alfabeta.

Ulya, H., Kartono., & Retnoningsih, A. 2014. "Analysis of Mathematics Problem Solving Ability of Junior High School Students Viewed from Students' Cognitive Style". *International Journal of Education and Research*. 2(10): 577-582.

Umaru, Y & Tukur, H.A. 2013. "The Influence of Dependent and Independent Cognitive Styles on Achievement in Mathematics among Senior Secondary School Students in Bida Educational Zone of Niger State, Nigeria*". Journal of Research in Education and Society*. 4(2): 60–67.

Vendiagrys, L., I. Junaedi, & Masrukan, 2015. "Analisis Kemampuan Pemecahan Masalah Matematika Soal Setipe TIMSS berdasarkan Gaya Kognitif Siswa pada Pembelajaran Model Problem Based Learning". *Unnes Journal of Mathematics Education Research*. 4(1):34-41.

Witkin, H.A., C. A. Moore., D. Goodenough., & P. W. Cox. 1977. "Field-Dependent and Field-Independent Cognitive Styles and Their Educational Implications". *Review of Educational Research.* 47(1): 1–64.

Zeyn, C.V., Roemintoyo., Nurhidayati, A. 2017. "Penerapan Model Pembelajaran Arcs (Attention, Relevance, Confidence, Satisfaction) Dan Alat Peraga Komponen Bangunan Untuk Meningkatkan Hasil Belajar Siswa Kelas X TGB SMK Negeri 2 Sukoharjo". *Jurnal Pendidikan Bisnis dan Ekonomi*.