Analysis of hard work character and students of PISA mathematics literature

Anis Munfarikhatin¹, Dian Mayasari¹, Irmawaty Natsir¹ and Yurfiah²

¹Department of Mathematics Education, Faculty of Teacher Training and Education, Indonesia University Musamus, Merauke, Indonesia
²Indonesian Language and Literature Education Study Program, Universitas Muhammadiyah Buton

E-mail: munfarikhatinfkip@unmus.ac.id

Abstract. Hard work is one of the character education contained in the 2013 curriculum. The implementation of the character of hard work in detailed learning in various indicators that cover all aspects in detail so that the observation of the character of hard work will be clearer. This research is a mixed research (qualitative and quantitative) with a mixture of unbalanced (Concurred Embedded) which aims to observe the character of students' hard work in the process of solving literacy problems. The steps in the research process are that the researcher conducts preliminary observations of 5 sample students who have been grouped into upper, middle and lower groups with variable hard work characteristics and literacy abilities. Early research using questionnaires showed that hard work in mathematics learning showed moderate results. While student literacy shows less results on various indicators of literacy skills. The results showed an increase in the character of hard work and mathematical literacy skills in selected subjects.

1. Introduction

Education is like the needs of human life that must be fulfilled because by getting a decent and quality human education will be considered to have high dignity. As revealed by Hudojo (1988: 1) that education is actually a complex series of events. Planting national character values has become an important and integrated reference for each subject, including mathematics. Character is the amount of moral and ethical quality development and demonstration of emotional traits in people's responses, thinking, reasoning, and behavior. [1]

Character education at this time has been considered important because the character has begun to erode by the development of time and technology from within and outside the country which has resulted in students not realizing that the Indonesian nation is a nation that upholds the dignity and personality of other nations. The character of hard work is a behavior that shows serious effort in various obstacles to learning, assignments and completing tasks as well as possible [2]. Sudharta (2014: 12) concluded "the character of hard work motivates students in improving achievement"[3]. While Ikhwanuddin (2012: 156) means that hard work is work full of enthusiasm and does not know despair if it fails [4]. The implementation of the character of hard work in detailed learning in various indicators that cover all aspects in detail so that the observation of the character of hard work will be clearer. Ministry of National Education (2010) formulates these indicators as follows. These indicators can be detailed as follows: (1) completing all tasks in a timely manner, (2) not despair5) always trying to be the best in doing assignments, (6) always proud of their own work, (7) making the best use of leisure time, (8) not...
cheating on tests, (9) able to propose new thoughts, (10) dare to ask questions, (11) dare to submit opinions, (12) not hesitate in answering questions, (13) never complain when given assignments, (14) show an enthusiastic attitude when given the task, (15) always feel satisfied with the results of their own work. In dealing with problems, (3) solving problems properly, (4) trying to gain as much knowledge as possible, (5) always trying to be the best in doing assignments, (6) always proud of their own work, (7) making the best use of leisure time, (8) not cheating on tests, (9) able to propose new thoughts, (10) dare to ask questions, (11) dare to submit opinions, (12) not hesitate in answering questions, (13) never complain when given assignments, (14) show an enthusiastic attitude when given the task, (15) always feel satisfied with the results of their own work.

In everyday life, students face problems related to personal, community, work, and scientific. Many of these problems are related to the application of mathematics. Good mastery of mathematics can help students solve the problem. The question is what mathematical abilities are needed to solve problems in everyday life. Or specifically, what mathematical competencies for 15-year-old children (obtained through school or special training) so that they are useful for their careers later or to continue their education to tertiary level. Therefore mathematics literacy is needed which is the foundation in solving problems in daily life.

Mathematical literacy is an individual's ability to identify, understand the role of mathematics in the world, make accurate judgments, use and involve mathematics in various ways to meet the needs of individuals as citizens who are reflective, constructive, and dedicated [5].

The Program for International Student Assessment, abbreviated as PISA, is a world-class assessment held in three years sponsored by the OECD (Organization for Economic Cooperation and Development) with 34 member states to determine the level of mathematics literacy of students around 15 years old. Mathematical literacy is an individual's ability to identify, understand the role of mathematics in the world, make accurate judgments, use and involve mathematics in various ways to meet the needs of individuals as citizens who are reflective, constructive, and dedicated [5].

**Table 1. Aspects of assessment in PISA**

| No | Aspects of Assessment | Mathematics |
|----|-----------------------|-------------|
| 1  | Definition            | The ability to recognize and understand the role of mathematics in the world, to be used as a foundation in using and engaging with mathematics in accordance with the needs of students as citizens who are constructive, caring and reflective. More functional use of mathematics requires the ability to recognize and formulate mathematical problems in various situations. |
| 2  | Dimensions of Content | Sector and mathematical concepts: Numbers (Quantity) Space and shape Change and relationships probability or uncertainty The ability that describes the skills of mathematical processes: Reproduction (Simple mathematical operations) Connections (combining ideas to solve problems directly). Reflection (broader mathematical thinking). In each group, the question of the degree of difficulty is varied and multilevel. |
| 3  | Process Dimensions    | Situations vary according to the relationships that exist in the environment. Personal. Education and work. Broad and Scientific Society |

The PISA oriented question in this study is a question that is tested referring to PISA questions that have been adjusted to students in Indonesia. PISA is a study of international literacy in reading (*reading literacy*), mathematics (*mathematics literacy*), problem-solving (*Problem Solving Literacy*), and science
(science literacy) and the latest is financial literacy. Indonesia itself has joined PISA since 2000. Assessment aspects in PISA are divided into 4 sections listed in table 1 [6].

One of the things that became the focus of PISA evaluation was mathematical literacy. The aim of the PISA math literacy test is to measure how students apply their knowledge to solve a set of problems in a variety of real contexts. To solve this problem, students must work on a number of mathematical competencies.

Literacy mathematics (mathematical literacy) is a skill possessed by an individual to identify and understand the roles played by mathematics in the real world, to make the opinions are quite reasonable, and to meet him in this life and to become, like something that is characteristic of building, connecting, and reflecting community citizens. The definition of mathematical literacy above was developed by a group of mathematicians in PISA. Mathematical literacy skills are measured using instruments in the form of tests at each meeting and at the end of the applied learning.

2. Methodology
The research method used in this study is a combination method (Mix Method) by combining qualitative and quantitative methods simultaneously. Quantitative methods in measuring mathematical literacy skills while qualitative methods are observed in students’ hard work. The application of the combination method in this study uses design concurred embedded unbalanced (mixture). Before the research is conducted, the researcher prepares the instrument in collecting quantitative research data in the form of RPP, syllabus, student books, student activity sheets, and tests of mathematical literacy skills. While the instruments in collecting qualitative data are questionnaires, interview questions, and observation sheets.

The process of collecting qualitative data in the form of questionnaires, interviews, and observations about students’ hard work is done simultaneously with quantitative data collection. While quantitative data collection uses the test method. In the quantitative research process, the experimental method is used by taking two classes, namely the experimental class and the control class with a random sampling technique. Where, as in qualitative research using data collection techniques with certain considerations (purposive sampling). The learning media in this study is to use a puzzle in which the literacy questions of mathematics are substituted. The use of variations in learning media will make learning more fun and not monotonous [7].

The puzzle referred to here is in the form of an interactive game consisting of nine (9) pieces of squares marked with numbers in each display which contain mathematical literacy problems.

The flow of the game puzzle is as follows.
1) Students in one class are divided into several groups, each group consisting of 5 (five) students.
2) Each group is given an initial score. This is because if the answer is wrong, the score will be reduced and each group must answer the questions they choose.
3) If the group concerned is unable to answer or answer incorrectly, then the other group has the right to answer and get an additional score.
4) The scores on each question are hidden and adjusted for the level of difficulty on each question.
5) The winning criteria can be determined in two ways as follows.

![Figure 1](image.png)

Figure 1. The formation of vertical, horizontal, lines and diagonal in the puzzle

5.1) If one group is able to answer all questions correctly by forming vertical, horizontal and diagonal straight lines in the puzzle box.
5.2) Group that gets the most scores in the game.
3. Result and discussion

3.1. Hard work character analysis
At the beginning, before the study was conducted, researchers had made observations about the character of students’ hard work through initial interview activities. Data from the researchers’ findings is that the character of students’ hard work is low.

![Figure 2. The score of the character of student hard work](image)

Students who belong to the upper group are taken only one person, namely students initials TW. Based on the above graph, it can be seen that the TW score of hard work character at the first meeting is 58 already classified as good, then continues to increase gradually until the 6th meeting of the learning process, the character score of hard work is 70 which is already high. At the beginning of the meeting, TW was not familiar with the learning method provided and was still at the adaptation stage. From a series of learning that has been implemented, it can be concluded that there is an increase in the confidence of the upper group students.

In the group, the researcher took a sample of 2 students, namely students with initials FBS and LZA students. In this group, the researchers also observed the character of their hard work from the first meeting to the final meeting. At the beginning of learning FBAS students have low hard work which is the main factor causing it is that students do not have an interest in the learning that has been done so far. From the observations made at each meeting during the learning with games puzzle applied, data obtained showing the FBAS hard work character score tended to increase even though it was not so high. Not much different from FBAS, students with initials LZA who are also in moderate ability at the beginning of the meeting also have a character of moderate hard work that is equal to 57. Before learning with puzzle games to solve PISA-oriented problems, LZA claims his willingness to learn is indeed low but if learning is done in a fun and interesting way, it will stimulate his enthusiasm to further increase his willingness to learn. At the end of the meeting the score of the results of the observation of LZA 69 hard-working characters who were classified as having high hard work.

In the lower group, the researchers also took 2 samples of students who had abilities that were not much different, namely students with the initials PR and GSN. At the beginning of learning PR students claimed to have never been serious in participating in learning because according to him all this time mathematics learning tended to be boring because there were too many formulas and identical to counting. In five learning meetings applied by researchers, the graph of the score of PR hard work tends to be unstable. At the first meeting, the score of PR hard work was 40. This shows that PR had moderate hard work and at the second meeting the hard work score had shown good criteria of 50. At the third meeting, the character of PR hard work had a slight increase which was at score 52. At the meeting, the fourth returns to increase at a score of 55, and at the end of the meeting the character of the hard work of public relations occupies a relatively high score of 56. From several meetings, the average character of hard work PR is 51.2. This is a moderate score, from a series of PR learning meetings that have shown an increase in character during the learning process with media puzzles to solve PISA-oriented problems.

At the beginning of the meeting before the researcher applies to learn with games puzzle problem claiming to be not interested in mathematics. He claimed that mathematics was difficult to understand,
therefore his willingness to work on the problems and problems was very low. From the graph shows the character score of GSN hard work initially only by 45 and this score continues at the second meeting. At the third meeting, it increased to 57 which means it has increased compared to the previous meeting. At the fourth meeting, it still remained at a score of 57. And at the end of the meeting increased to 62. Overall there was an increase in the character of hard work on the five students who were the subjects of choice.

3.2. Mathematics literacy capability analysis
Based on the results of initial observations, students' mathematical literacy abilities are still relatively low. It can be observed from the test results of mathematical literacy skills that generally indicates the students' answers have not been able to achieve aspects of formulating, use (employ), and interpret questions related to mathematical literacy. In the results of the pretesting of Pythagoras' material literacy skills, most students were only able to communicate. At the stage of formulating, employing and interpreting students' abilities are still relatively low. This is because students are not able to associate the concepts and knowledge they get in the classroom with the literacy problems that the researchers provide. The students claimed that they were not used to working on questions with the form of questions that emphasized thinking skills because all this time the learning they got was by counting and remembering formulas. Habit in solving problems in the form of story problems is also lacking. The problems they encountered especially in Pythagoras material were generally simpler.

That can be known from the results of the work of TW students is that he has been able to mention the information known from the problem. But he has not been able to formulate, employ, and interpret the question. From the results of interviews with TW students, he claimed to not understand what to do after knowing the information that was known in the matter. From the work of TW students, he was able to sketch the problem, namely the shape of the carpet is a rectangle with a size of 150 cm x 100 cm. The next step he should do is determine the sloping or diagonal side of the magazine size. But he instead looked for the area of carpet used to coat the wall. This is an error made by TW. This means that TW has not been able to formulate, employ and interpret what is known from the different problem.

Not much different from the upper group, LZA students who were the middle group sample also experienced difficulties in the process of solving the problem of pretesting mathematical literacy skills. The first analysis of LZA students based on interviews found the fact that the students misinterpreted the problem. On the problem that must be solved is the minimum iron length that will be used to make the goalmouth. However, from the results of LZA's work, it can be seen that he only arrived at calculating the goal height. However, LZA has been able to communicate (communication) as evidenced by the correct sketch of the image and then be able to formulate problems mathematically (formulate). However, in the aspect of solving the problem of concepts, facts, and reasoning (Employ) LZA is not perfect, as evidenced by the unresolved question number 4.
The results of the achievement of the lower group literacy abilities also showed fewer results. The results of interviews from PR students can be concluded that these students have not been able to analyze the information contained in the problem. This is proven by public relations students who are not able to draw a known sketch. It appears that the work of public relations students has not been able to give steps to answer correctly. He has not been able to manage the information (communication), to formulate the problem (formulate), problem-solving (employ) and evaluate the results of his work (interpret).

Most students claimed not to be familiar with the problems that the researchers gave. According to them the questions given seemed difficult and difficult to understand. The students claimed that they were not used to solving literacy questions related to their daily lives. They think mathematics is identical to counting, memorizing complicated formulas and symbols.

The application of learning with media puzzle questions in improving students' literacy skills shows effective results. From the results of the implementation, the enthusiasm of students at this stage was very high, as evidenced by the high competition between groups. The challenging game rules and heterogeneous group divisions based on their level of mathematical literacy are some of the factors that influence moods students’.

The final state of Mathematics literacy skills shows that there is an increase in students' mathematical literacy skills because learning using question puzzles is learning that emphasizes cooperative student activity with game media, which is puzzle question. Students' ability to work on mathematical literacy questions is packed with fun with puzzles containing literacy questions, and students will be challenged to answer because each group must get as many scores as possible and at the end of the meeting will be rewarded.

From the results of the gain test, the results of the description of literacy abilities are obtained as follows.

1. The upper group subject with level 5 literacy skills shows students can work with models for complex situations, know the obstacles faced, and estimate them. Top group students can choose, compare and evaluate strategies to solve complex problems related to this model. Students at this level can work using broad thinking and reasoning, and can appropriately connect their mathematical knowledge and skills to the situation at hand. They can reflect on what they are doing and communicate it.

2. The subject of the moderate group with level 4 literacy abilities of the middle group students can work effectively with the model in concrete, but complex situations. They can choose and interpret different representations and relate them to real situations. Medium group students at this level can
use their skills well and use flexible reasons and views according to the context. They can provide explanations and communicate them with arguments based on their interpretations and actions.

3. The lower group subjects with level 3 literacy skills can implement the procedure well including procedures that require decisions in sequence. They can choose and implement simple problem-solving strategies.

Based on the level of mathematical literacy skills in the PISA study the five student choices are at different levels.

4. Conclusion
From the research conducted, the following results can be obtained.
1. The initial condition of the character of hard work in the upper and middle groups on average has a moderate level of hard work. This is due to a lack of interest in the classroom learning process. Whereas in the lower groups the character of hard work is still low because they have not yet realized the importance of applying mathematics in everyday life.
2. The initial conditions of mathematical literacy skills indicate that students still find it difficult to solve story problems. Most of them are lacking in applying the concepts they learn to apply in everyday life.
3. The final condition of the character of hard work after learning with games puzzle shows that in the upper group they have high hard work. In the middle group, they have moderate hard work but the hard work character score is at the upper limit of the high and medium scores. In the lower group, the hard work character score is in the sufficient category. The thing that lies behind it is the lack of interest in the learning process and other factors beyond observation in classroom learning activities.
4. The final condition of students' literacy skills in the upper group is that students have reached level 5 where students have been able to choose, compare and evaluate strategies to solve complex problems. In moderate group students, they can work effectively in concrete situations. Whereas in the lower group students they have been able to carry out procedures to choose and apply well in solving simple problems.

References
[1] Hudojo H 1988 Mengajar Belajar Matematika (Jakarta: Depdikbud)
[2] Kemdikbud 2010 Bahan Pelatihan Penguatan Metodologi Pembelajaran berdasarkan Nilai-Nilai Budaya untuk Membentuk Daya Saing dan Karakter Bangsa (Jakarta)
[3] Sudharta N A 2014 Pengelolaan Karakter Kejujuran dan Kerja Keras Dalam Pembelajaran Matematika Kontekstual Di Sekolah Dasar Negeri Kusumodilagan (Surakarta: Universitas Muhammadiyah Surakarta)
[4] Ikhwanuddin I 2012 Implementasi Pendidikan Karakter Kerja Keras Dan Kerja Sama Dalam Perkuliahan J. Pendidik. Karakter 2
[5] OECD 2003 PISA 2003 Assessment Framework
[6] Stacey K 2010 Mathematical and scientific literacy around the world J. Sci. Math. Educ. Southeast Asia 33 1–16
[7] Suryani D R and Lestari N 2019 Penggunaan variasi media pembelajaran untuk meningkatkan motivasi dan minat belajar matematika siswa kelas XI ips 3 SMA Negeri 2 Merauke Musamus J. Math. Educ. 1 74–9