

Analysis of Conceptual Understanding, Digital Literacy, Motivation, Divergent of Thinking, and Creativity on the Teachers Skills in Preparing Hots-based Assessments

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Abstract--- The low achievement of Indonesian students in international studies (PISA, TIMSS, and PIRLS) which measures high-order thinking skills (HOTS) in solving contextual problems, become a serious problem in improving the quality of education in Indonesia. Teachers should be able to facilitate students to have sufficient knowledge and experience to improve students' higher order thinking skills through the provision of HOTS-based assessments. This study aimed to analyze the skills of high school (SMA) / vocational high school (SMK) mathematics teachers to develop HOTS-based assessments in terms of conceptual understanding, digital literacy, motivation, divergent of thinking, and creativity. This research was survey research. The study population was SMA / SMK mathematics teachers in the provinces of Bali, NTB, and NTT. Sampling was done by using cluster random sampling technique, with a total sample of 400 teachers. The research data were collected using questionnaire. Data were analyzed using path analysis technique using SPSS 23.0 program. The results of data analysis showed that: (1) understanding the HOTS concept had direct positive effect on digital literacy, (2) understanding the HOTS concept had direct positive effect on creativity, (3) digital literacy had direct positive effect on creativity, (4) motivation had direct positive effect on creativity, (5) divergent of thinking had direct positive effect on creativity, (6) understanding of the HOTS concept had direct positive effect on the ability of teachers to compile HOTS-based assessments, (7) digital literacy had a direct positive effect on the ability of teachers to compile HOTS-based assessments, (8) motivation had a direct positive effect on the ability of teachers to compile HOTS-based assessments, (9) divergent of thinking had direct positive effect on the ability of teachers to compile HOTS-based assessments, (10) creativity had direct positive effect on the ability of teachers to compile HOTS-based assessments.

Keywords--- HOTS Concept, Digital Literacy, Motivation, Divergent of Thinking, Creativity, HOTS-based Assessment.

I. Introduction

The policy of increasing teacher competence in learning and assessing is one of the government focuses to Improve the quality of education. In the aspect of assessment, teachers are currently required to be able to develop assessment based on higher order thinking skills (HOTS). Teachers must be able to equip students with life skills in the VUCA era (Volatility, Uncertainty, Complexity, and Ambiguity). An era filled with turmoil, uncertainty, complexity, and ambiguity. Changes that occur so fast in all aspects of human life. This condition requires HOTS skills including critical thinking skills, innovation and creativity, collaboration, and communication. Teachers should be able to provide these skills through sufficient training to carry out HOTS-based assessments in schools (Sudiarta and Widana, 2019). Therefore, teachers must be able to develop HOTS-based assessments, so that students are trained to solve contextual problems that require higher-order thinking skills.

Teachers' understanding of the basic concepts of HOTS-based assessment is very important before teachers start writing HOTS-based assessments. The HOTS-based assessment is an assessment that does not simply remember, restate, or refer without processing, but an assessment that functions to measure higher-order thinking skills, including the ability to transfer one concept to another, processing and applying information, finding the links from a variety of different information, using information to solve problems, and critically analyzing ideas and information (Widana, et.al., 2019). In Bloom's taxonomy (Krathwohl David R, 2002), HOTS-based assessment generally measures the ability in the domains of (a) to analyze with the characteristics of the ability to parse,

compare, examine, criticize, test, and so on; (b) evaluating with characteristics, including evaluating, assessing, refuting, deciding, choosing, supporting, predicting, etc; and (c) creating includes the ability to construct, design, create, develop, write, combine, formulate, and others. These three domains of higher-order thinking skills are important in solving contextual problems, transferring learning outcomes, and building innovation and creativity.

Digital literacy is a person's ability to process various information in digital form so that they are able to communicate effectively with others in various forms, and understand when and how technology can achieve goals (Widana, 2020). Including creativity and critical thinking about the various positive and negative impacts that may occur due to the use of technology in everyday life. Digital technology allows people to be able to interact and communicate with other people anywhere and anytime. Belshaw (2011) states that there are 8 essential factors that are indispensable for developing digital literacy, namely competencies relating to analysis in assessing content, related habits with an understanding of the various contexts of digital users, constructive / creator abilities, communicative in understanding the performance of networks and communication in digital era, responsible confidence, creative in doing new things with new ways, critical in facing content, and socially responsible.

One of the important factors for increasing work productivity is motivation, which is force that provides stimulation or encouragement and work enthusiasm for someone so that they can change that person's behavior to increase performance productivity as desired (Rahardjanto, et.al., 2019). Teacher's working motivation is needed to improve the quality of learning and assessment in schools. Internal motivation is motivation that arises as a result of encouragement from within of each individual to do work without any compulsion from others but on their own accord. The factors that affect internal motivation include interest, namely the tendency and high enthusiasm / desire to do certain jobs (Sadia & Uzma, 2012). Interest is a person's liking or interest in something so that it encourages that person to master knowledge and experience, this can be shown through participation and activeness in seeking that knowledge and experience, the characteristics of interest are person's liking and interest in what is done, someone's desire to work, greater attention to thingsdone, the participation and activity of someone in doing a job. In addition, intrinsic motivation is also influenced by the existence of clear goals (ideals), so that it can encourage someone to do work with high enthusiasm. Commitment is driving factor for internal motivation, namely consistent attitude in the form of promise that comes out of a person to complete certain jobs (Erjati Abas, 2019).

Wan Fauziah Wan Yusof, et.al. (2013) stated that motivation is also influenced by conditions outside of the teacher itself which is called external motivation. Factors that influence external motivation include giving gifts to someone as an award or a memento in the form of a souvenir for the work achieved. Gift giving needs to be done because it is felt to be effective enough to motivate someone to achieve certain goals. Punishment is educational not because revenge can also motivate to improve one's performance. The educational approach in question is an educational punishment and aims to improve the attitudes and actions of someone who is considered wrong. Another factor is competition or rivalry, which can be used as motivational tool in the form of competition between individuals and between groups. If the competition is managed properly, it can encourage someone to work harder to achieve the goals set so as to create conducive atmosphere. Recognition of the leadership and work environment towards one's work achievements is an important part of improving one's performance.

Divergent of thinking is a person's skill to construct various possible ideas or alternatives to solving a problem. Divergent of thinking has characteristics, including the search for unusual (non-routine) possibilities in constructing ideas, the existence of process of interpretation and evaluation of ideas to think of various possible ideas that make sense (Mark & Selcuk, 2012). Divergent of thinking is type of thinking ability that has the potential to be used when a person solves problems creatively to produce various solutions to problems with various procedures and the right reasons, so that it is one of the factors that affect a person's ability to think at high levels (Marisha, 2016). divergent thinking skills, namely flexibility, namely thinking flexibility, which includes the ability to see objects, situations or problems from various points of view, and use various ways to solve problems; originality, which is unusual thinking, is form of authenticity of thinking about something that other people have not thought of or is not the same as people's thoughts in general and is able to come up with new and unique ideas; fluency, includes the fluency of a person expressing many ideas, generating many ideas that are relevant to the problem; elaboration, namely the ability to detail main idea into smaller ideas to solve problems, develop ideas, and make implications from the information available (Ritter, 2020).

Madiah, et.al. (2020) states that creativity is a person's ability to produce something new through a process of modification, combining, connecting, formulating methods, ideas, ideas that have existed before so that they can be used to solve problems that were not thought of before. Creativity can also be defined as the ability to create ideas, see new or unexpected relationships, the ability to formulate concepts that don't just memorize, create new answers to problem solving and get new challenges that need to be answered (Tohir, et.al., 2018). Creativity is a thinking

skill in high level which implies an escalation in thinking skills marked by succession, discontinuity, differentiation, and integration between each developmental stage (Arlene Egan, et.al., 2017).

Tang, Werner, Gruszka, & Tang (2017) state that creativity can be viewed as an inseparable part consisting of 4P dimensions (Person, Process, Press, and Product). The four dimensions of P are interrelated, namely the creative person who is involved in the creative process, with encouragement and support (Press) from the environment to produce creative products. In the person dimension, creativity is related to existing abilities or skills. in someone who is closely related to talent (talent). The characteristics of personal creative thinking abilities include: fluency is related to the ability to generate many ideas, originality, the ability to spark original ideas, elaboration is the ability to parse something in detail, flexibility, namely understanding the differences in how others view the solution of a problem and redefinition, namely the ability to review a problem based on a different perspective from what many people already know.

In the dimension process, creativity is focused on the thought process so as to generate unique or creative ideas, emphasizing the aspects of the change process (innovation and variation). As a process, creativity occurs in the human brain to find and develop new ideas that are more innovative and varied, so divergent thinking skills are needed. The most important part in developing creativity is the creative process in which someone feels capable and happy to busy themselves creatively with the activities they have done. Furthermore, in terms of dimension of the press, creativity is emphasized on encouragement, both internal self-encouragement in the form of desire and desire to create or engage in creative self, as well as external encouragement from the social and psychological environment. In this case, external motivation is very important to develop a person's internal motivation, so that they will be creative without feeling forced and there are no certain interventions (Neeraj & Rajib, 2015).

From a product point of view, creativity is focused on the product or what a person produces. Creative products emphasize originality, namely the ability to produce something new. In addition, creativity in the product dimension is defined as the ability to make new combinations that have social meaning. Thus, creativity does not only create something new but may also be a combination of something that already existed. Mathias Benedek, et.al. (2014) stated that creative products are classified into 3 categories: novelty, namely the extent to which the product is new in terms of new processes, new techniques, new concepts, creative products in the future and original products that are very rare among products made by people with experience and the same training, causing surprises and can also generate other original product ideas; solution, namely the extent to which the product meets the need to solve the problem (the product must be meaningful, logical, useful); and detail (elaboration and synthesis), the extent to which the product is able to combine different / similar elements into a sophisticated and coherent product unit.

Several previous studies are relevant to this study state that the skills of teachers to develop HOTS-based assessments can be influenced by several factors. Kanfer, et.al. (2017) in their research on the relationship between motivation and work productivity, stated that motivation is a very important topic for improve one's performance. This means that teacher work motivation affects the ability of teachers to develop HOTS-based assessments. Triwati Rahayu (2017) argued that information literacy is the ability to seek, understand, evaluate critically, and manage information for knowledge that is useful for the development of her personal and social life. Information literacy has a direct effect on the ability of teachers to compile HOTS-based assessments. Likewise Rino Richardo, et.al. (2014) in their research on the creativity of class IX students at MTs Negeri Plupuh, Sragen Regency in solving contextual math problems, stated that students' creativity found solving mathematical problems was strongly influenced by divergent thinking styles and achievement motivation. In relation to the teacher's ability to develop HOTS-based assessments, it is influenced by the creativity of a teacher.

II. Method

This research was asurvey research. The study population was SMA / SMK mathematics teachers in the provinces of Bali, NTB, and NTT. Sampling was done by using cluster random sampling technique, with a total sample of 400 teachers.

Independent variable data (understanding of the HOTS assessment concept, digital literacy, work motivation, divergent of thinking, and creativity) and dependent variable data (the skills of high school / vocational high school mathematics teachers in preparing HOTS-based assessments) were collected using a questionnaire. The data were analyzed using path analysis techniques using the SPSS 23.0 program. The constellation of the independent and dependent variables can be described as follows.

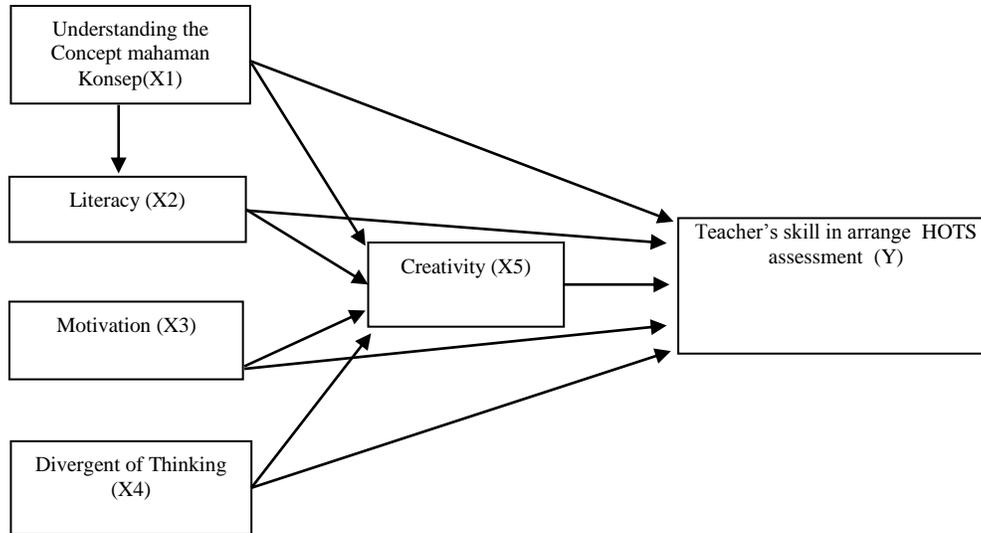


Figure 1: Constellation of Independent and Dependent Variables

III. Results and Discussion

The result of research data in the form of independent variables data and dependent variables were analyzed using path analysis techniques using the SPSS 23.0 program. In accordance with the constellation of the independent and dependent variables in Figure 1 above, resulting 3 sub-structures are as follows.

1. Sub-structure 1

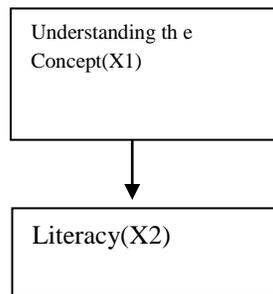


Figure 2: Substructure 1

The results of sub-structure data analysis 1 are presented in table 1 and table 2 below.

Tabel 1: ANOVA ^a						
Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	7412.514	1	7412.514	88.081	.000 ^b
	Residual	33493.923	398	84.156		
	Total	40906.437	399			
a. Dependent Variable: Digital_literation						
b. Predictors: (Constant), Concept_understanding						
Tabel 2: Coefficients ^a						
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	28.230	2.361		11.959	.000
	Concept_understanding	.435	.046	.426	9.385	.000
a. Dependent Variable: Digital_literation						

Based on table 1. Anova^a shows that the F value is 88.081 with a sig. = 0.000 <0.05 (significant). This means that understanding the HOTS concept (X1) has a direct positive effect on Digital Literacy (X2). In table 2. Coefficients^a shows the path coefficient of 0.426 with sig. = 0.000 <0.05 (significant).

2. Sub-structure 2

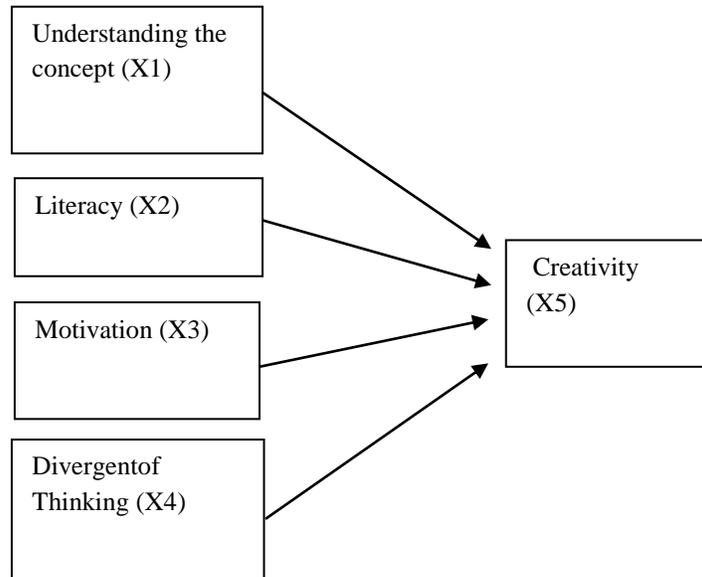


Figure 3: Substructure 2

The results of the sub-structure 2 data analysis are presented in table 3 and table 4 below.

Tabel 3: ANOVA ^a						
Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	9613.484	4	2403.371	31.700	.000 ^b
	Residual	29947.626	395	75.817		
	Total	39561.110	399			
a. Dependent Variable: Creativity						
b. Predictors: (Constant), Divergent_of_thinking, Motivation, Digital_literation, Concept_understanding						
Tabel 4: Coefficients ^a						
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	18.961	2.882		6.579	.000
	Concept_understanding	.136	.061	.136	2.246	.025
	Digital_literation	.158	.055	.161	2.897	.004
	Motivation	.115	.049	.116	2.356	.019
	Divergent_of_thinking	.213	.066	.213	3.221	.001
a. Dependent Variable: Creativity						

Look at table 4. Coefficients^a

- The path coefficient value for understanding the HOTS assessment concept is 0.136 with sig. = 0.000 <0.05 (significant). This means that understanding the HOTS concept has direct positive effect on creativity.
- The coefficient value of the digital literacy path is 0.161 with sig. = 0.025 <0.05 (significant). This means that digital literacy has direct positive effect on creativity.
- The value of the motivation path coefficient is 0.116 with sig. = 0.019 <0.05 (significant). This means that motivation has direct positive effect on creativity.
- The coefficient value of divergent thinking path is 0.213 with sig. = 0.001 <0.05. That is, divergent thinking has direct positive effect on creativity.

3. Sub-structure 3

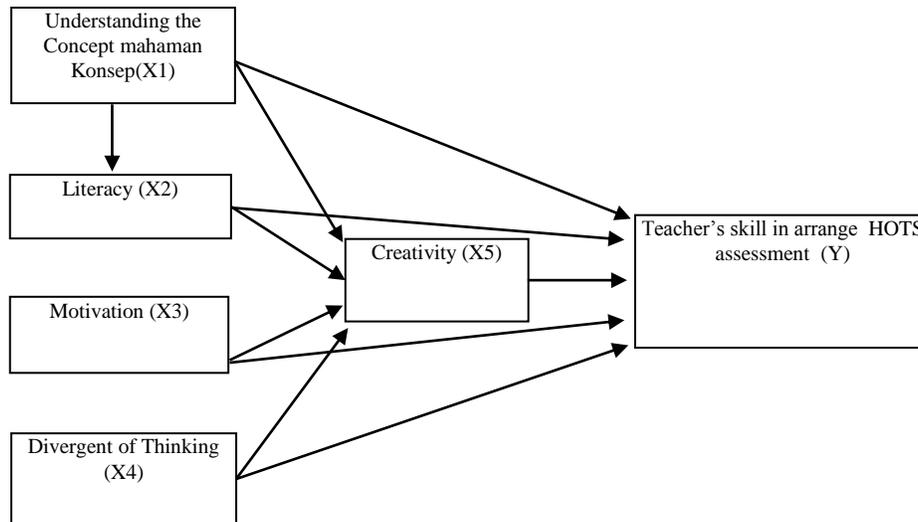


Figure 4: Sub-structure 3

The results of sub-structure data analysis 3 are presented in table 5 and table 6 below.

Tabel 5: ANOVA ^a						
Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	39896.824	5	7979.365	10237.746	.000 ^b
	Residual	307.086	394	.779		
	Total	40203.910	399			
a. Dependent Variable: HOTS_assessment						
b. Predictors: (Constant), Creativity, Motivation, Concept_understanding, Digital_literation, Divergent_of_thinking						
Tabel 6: Coefficients ^a						
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	-16.892	.308		-54.879	.000
	Concept_understanding	.384	.006	.379	61.930	.000
	Digital_literation	.457	.006	.461	81.760	.000
	Motivation	.317	.005	.317	63.771	.000
	Divergent_of_thinking	.015	.007	.015	2.257	.025
	Creativity	.164	.005	.163	32.201	.000
a. Dependent Variable: HOTS_assessment						

Look at table 6. Coefficients^a above:

- a. The path coefficient value for understanding the HOTS assessment concept is 0.379 with sig. = 0.000 < 0.05 (significant). This means that understanding the HOTS concept has direct positive effect on the ability of teachers to compile HOTS-based assessments.
- b. The coefficient value of the digital literacy path is 0.461 with sig. = 0.000 < 0.05 (significant). This means that digital literacy has direct positive effect on the ability of teachers to compile HOTS-based assessments.
- c. The coefficient value of the pathway of motivation is 0.317 with sig. = 0.000 < 0.05 (significant). This means that motivation has direct positive effect on the ability of teachers to make HOTS-based assessments.
- d. The coefficient value of divergent of thinking path is 0.015 with sig. = 0.025 < 0.05 (significant). This means that divergent of thinking has direct positive effect on the ability of teachers to compile HOTS-based assessments.
- e. The coefficient value of the creativity path is 0.163 with sig. = 0.000 < 0.05 (significant). This means that creativity has direct positive effect on the ability of teachers to compile HOTS-based assessments.

The research data above shown that variables previously thought had direct positive effect on the ability of SMA / SMK mathematics teachers to compile HOTS-based assessments are indeed proven. The selection of independent variables such as understanding HOTS assessment concept, digital literacy, work motivation, divergent of thinking, and creativity is based on theoretical concepts formulated from various literature and theories. It turns out that the research data states that these variables have a direct positive effect on abilities of SMA / SMK mathematics teachers to prepare a HOTS-based assessment. The research data shows that it supports the correctness of these theories. Based on the above research results, it can be concluded that the teacher's inability to compile HOTS questions is caused by several variables, including understanding the HOTS assessment concept, digital literacy, work motivation, divergent of thinking, and creativity. However, it does not rule out that there are other factors that were not examined in this study, which affect the ability of teachers to compile HOTS-based assessment in addition to the above variables.

IV. Conclusion

In accordance with the results of analysis and discussion above, it can be concluded that: (1) understanding HOTS concept has direct positive effect on digital literacy; (2) understanding HOTS concept has direct positive effect on creativity; (3) digital literacy has direct positive effect on creativity; (4) motivation has direct positive effect on creativity; (5) divergent of thinking has direct positive effect on creativity; (6) understanding of HOTS concept has direct positive effect on the ability of teachers to compile HOTS-based assessments; (7) digital literacy has direct positive effect on the ability of teachers to compile HOTS-based assessments; (8) motivation has direct positive effect on the ability of teachers to compile HOTS-based assessments; (9) divergent of thinking has direct positive effect on the ability of teachers to compile HOTS-based assessments; (10) creativity has direct positive effect on the ability of teachers to compile HOTS-based assessments.

Recommendations that can be conveyed are as an effort to improve the competence of SMA / SMK mathematics teachers to develop HOTS-based assessments, it can be done through training / IHT, mentoring, or providing material in the form of modules or e-books. This needs to be done in order to improve teachers' understanding of the HOTS assessment concept, and other factors that directly affect the ability of teachers to develop HOTS-based assessments.

Acknowledgement

The highest gratitude and appreciation are conveyed to the Head of the Bali Provincial Education Office, the Head of the West Nusa Tenggara Province Education and Culture Office, the Head of the East Nusa Tenggara Provincial Education Office, the Directorate of Research and Community Service, the Directorate General of Higher Education, SMA / SMK Mathematics teachers in the Provinces of Bali, West Nusa Tenggara and East Nusa Tenggara for the implementation of this research so that it can run smoothly and in accordance with the objectives.

References

- [1] Egan, A., Maguire, R., Christophers, L. and Rooney, B. Developing creativity in higher education for 21st century learners: A protocol for a scoping review. *International Journal of educational research* **82** (2017) 21-27.
- [2] Belshaw, D. *What is' Digital Literacy*. A Pragmatic investigation, 2011.
- [3] Abas, E. The Effect of Madrasah Principal's Leadership and Teachers' Work Motivation on Learning Effectiveness in Bandar Lampung. *Peuradeun Scientific Journal* **7** (2) (2019) 305-314.
- [4] Kanfer, R., Frese, M. and Johnson, R.E. Motivation related to work: A century of progress. *Journal of Applied Psychology* **102** (3) (2017) 338.
- [5] Krathwohl, D.R. A revision of Bloom's taxonomy: An overview. *Theory into Practice* **41** (4) (2002) 212-218.
- [6] Khalid, M., Saad, S., Hamid, S.R.A., Abdullah, M.R., Ibrahim, H. and Shahrill, M. Enhancing creativity and problem solving skills through creative problem solving in teaching mathematics. *Creativity Studies* **13** (2) (2020) 270-291.
- [7] McAuliffe, M. The potential benefits of divergent thinking and metacognitive skills in STEAM learning: A discussion paper. *International Journal of Innovation, Creativity and Change* **2** (3) (2016) 71-82.
- [8] Runco, M.A. and Acar, S. Divergent thinking as an indicator of creative potential. *Creativity Research Journal* **24** (1) (2012) 66-75.

- [9] Benedek, M., Jauk, E., Sommer, M., Arendasy, M. and Neubauer, A.C. Intelligence, creativity, and cognitive control: The common and differential involvement of executive functions in intelligence and creativity. *Intelligence* **46** (2014) 73-83.
- [10] Jaiswal, N.K. and Dhar, R.L. Transformational leadership, innovation climate, creative self-efficacy and employee creativity: A multilevel study. *International Journal of Hospitality Management* **51** (2015) 30-41.
- [11] Nurmitasari, N. and Astuti, R. The level of creative thinking of MTs students. On a flat wake reviewed by gender. *Journal e-DuMath* **3** (2) (2017) 118-128.
- [12] Rashid, S. and Rashid, U. Work motivation differences between public and private sector. *American International Journal of Social Science* **1** (2) (2012) 24-33.
- [13] Sudiarta, I.G.P. and Widana, I.W. Increasing mathematical proficiency and students character: lesson from the implementation of blended learning in junior high school in Bali. *In Journal of Physics: Conference Series* **1317** (1) (2019) 012118.
- [14] Rahardjanto, A. Hybrid-PjBL: Learning Outcomes, Creative Thinking Skills, and Learning Motivation of Preservice Teacher. *International Journal of Instruction* **12** (2) (2019) 179-192.
- [15] Rahayu, T. Development of Higher Level Thinking Skills through the National Literacy Movement. *Progress of the 2nd National Seminar on Progressive and Fun Education*, 2017.
- [16] Richardo, R., Mardiyana, M. and Sari, D.R. Student Creativity Levels in Solving Divergent Mathematical Problems in terms of Student Learning Styles (Studies in Class IX Students of Plupuh State MTS, Sragen Regency Odd Semester, 2013/2014 Academic Year). *Journal of Learning Mathematics* **2** (2) (2014).
- [17] Ritter, S.M., Gu, X., Crijns, M. and Biekens, P. Fostering students' creative thinking skills by means of a one-year creativity training program. *PLoS One* **15** (3) (2020) e0229773.
- [18] Gruszka, A. and Tang, M. *The 4P's creativity model and its application in different fields*. In Handbook of the management of creativity and innovation: Theory and practice, 2017, 51-71.
- [19] Tohir, M., Abidin, Z., Dafik, D. and Hobri, H. Students creative thinking skills in solving two dimensional arithmetic series through research-based learning. *IOP Conf. Series: Journal of Physics: Conf. Series* **1008** (2018) 012072.
- [20] Yusoff, W.F.W., Kian, T.S. and Idris, M.T.M. Herzberg's two factors theory on work motivation: does its work for today's environment. *Global journal of commerce and Management* **2** (5) (2013) 18-22.
- [21] Widana, I.W. Application of simpang tegar method: Using data comparison. *Journal of Advanced Research in Dynamical and Control Systems* **11** (2) (2019) 1825-1832.
- [22] Widana, I.W. The Effect of Digital Literacy on the Ability of Teachers to Develop HOTS-based Assessment. *In Journal of Physics: Conference Series* **1503** (1) (2020) 012045.