Infinity Journal of Mathematics Education
Volume 9, No. 2, September 2020
https://doi.org/10.22460/infinity.v9i2.p183-196

p-ISSN 2089-6867
e–ISSN 2460-9285

RELATIONSHIP BETWEEN STATISTICAL LITERACY AND MATHEMATICAL REPRESENTATION OF STUDENTS THROUGH COLLABORATIVE PROBLEM SOLVING MODEL

Johannis Takaria[1*], Wahyudin[2], Jozua Sabandar[3], Jarnawi Afgani Dahlan[2]
[1]Universitas Pattimura, Indonesia
[2]Universitas Pendidikan Indonesia, Indonesia
[3]Institut Keguruan dan Ilmu Pendidikan Siliwangi, Indonesia

Article Info

Article history:

Received Mar 14, 2020
Revised Sep 5, 2020
Accepted Sep 6, 2020

Keywords:

Statistical literacy,
Mathematical representation,
CPS learning model

ABSTRACT

The purpose of this study was to find out the relationship between statistical literacy and mathematical representation of students as pre-service elementary school teachers through the Collaborative Problem Solving (CPS) model. The relationship between statistical literacy and mathematical representation was analyzed by using a product-moment correlation with a sample of 35 students of Elementary School Teacher Education Study Program at one of the state universities in Ambon City. The results showed that there was a positive and strong relationship between statistical literacy and mathematical representation with a correlation value of 0.66. This relationship means that if students have good mathematical representation abilities, statistical literacy abilities are also getting better. Exploration of statistical literacy and mathematical representation abilities can be facilitated by using The CPS learning model. The CPS learning model can facilitate student learning as a structure in mathematical thinking so that statistical literacy and mathematical representation abilities of students can be explored through the transformation of ideas among students. The CPS learning model aspects were implemented in high and very high categories while the indicators were at rating-2 and rating-3.

Corresponding Author:

Johannis Takaria,
Department of Mathematics Education,
Universitas Pattimura
Jl. Ir. M. Putuhena, Poka, Tlk. Ambon, Maluku 97233, Indonesia
Email: johannistakaria007@gmail.com

How to Cite:

Takaria, J., Wahyudin, W., Sabandar, J., & Dahlan, J. A. (2020). Relationship between statistical literacy and mathematical representation of students through collaborative problem solving model. *Infinity*, *9*(2), 183-196.

1. INTRODUCTION

Thinking skills are important to be developed in statistical and mathematical learning. Hendriana et al. (2019) stated that mathematical thinking skills are the focus of mathematical learning in schools. Takaria and Talakua (2018a) stated that the abilities of students in statistical learning must be supported by good mathematical abilities so that

students can be actively involved in facing and solving various challenging statistical problems.

Statistics in the school curriculum is an integrated material in mathematics. Best and Khan (1995) stated that statistics are part of mathematical techniques, related to the collection, organization, analysis, and interpretation of numerical data. Mastery of statistical concepts requires students to have good mathematical abilities.

In higher education, statistics are taught separately and not integrated into mathematics, but mathematics is crucial in understanding statistics. Takaria (2015) showed a gap between the importance of statistics and the abilities of students. It was found that the statistical abilities of students as pre-service elementary school teachers at one of the state universities in Ambon City had not yet achieved the expected results. This is caused by the lack of basic skills in statistics and mathematics. There is a lack of basic statistical knowledge possessed by students, so that showed a phobia of mathematics and statistical anxiety that had an impact on learning interest (Garfield, 1995; Garfield & Ahlgren, 1988; Tishkovskaya & Lancaster, 2010; Verhoeven, 2006). Garfield (1995) stated that in statistical learning, students are not empowered to apply aspects of statistical knowledge in solving general problems from certain contexts.

Based on the researcher's experience as a teaching lecturer in educational statistics courses and basic concepts of mathematics, it was found that problems with basic statistics and mathematics knowledge is also a problem for students who are pre-service elementary school teachers in the study location. In the basic ability of mathematical compute operations, students made a frequency distribution table to determine classes by using the Sturgess rule $k = 1 + 3.3 \log n$. Students showed wrong basic calculation skills, where students added $1 + 3.3$ first then the results were multiplied by $\log n$. This showed that students did not understand the level in mathematical operations, $3.3 \log n$ was completed first, then the result was added with 1.

Other findings showed that students calculated the average by not using the procedure correctly. Students are directly calculated without writing the equations and statistical symbols first. The basic ability of analysis and interpretation is important to be improved, especially the ability to understand statistical information, read and write (graphs and tables), and interpret correctly. The main thing that is often overlooked by students is not writing the title of tables and graphs.

Statistical and mathematical learning requires literacy. Fatmanissa and Sagara (2017) stated that literacy is the ability to read and write that is used when reading and understanding a problem to be written in a mathematical model. Literacy has been developed in various fields, one of which is statistical literacy, although there are still many problems with statistical knowledge.

Lack of statistical knowledge due to low statistical literacy abilities. The lack of statistical literacy abilities is due to the inability to apply it in everyday life (Gal, 2002; Tishkovskaya & Lancaster, 2010; Verhoeven, 2006). Schield (1999) stated that statistical literacy is more than just the use of numbers, but individuals must be able to understand what is affirmed, think critically about statistical arguments, and have inductive reasons for those arguments.

Research conducted by Watson (2003) found that statistical literacy is important and becomes part of the curriculum. According to him, several factors that contribute to the development of statistical literacy in schools are due to: 1) the expectation to participate as citizens in accessing information related to data; 2) the importance of abilities and skills in every possible decision making on data.

Basic skill and is important to use in understanding statistical information or research results. These skills aim to organize data, compile and display tables, and work with different

data representations. Statistical literacy also includes an understanding of concepts, vocabulary, symbols, and includes an understanding of probability as a measure of uncertainty (Ben-Zvi & Garfield, 2004; Callingham & Watson, 2017).

This problem is inversely proportional to the importance of statistical literacy. The reading and interpreting statistical reports requires statistical literacy abilities which include sufficient knowledge and understanding of calculations, statistics, understanding of literacy in general, utilize quantitative data for data presentation and make summary reports on personal or professional assignments (Chick & Pierce, 2013; Gal, 2002; Ben-Zvi & Garfield, 2004; Watson, 2006). The study on statistical learning stated that statistical learning through problem-solving can improve student skills, especially when they interact directly with data (Garfield, 1995; Garfield & Ben-Zvi, 2007; Marriott et al., 2009).

Statistical literacy is the ability to critically interpret and evaluate statistical information in argument-based data on various media channels and their ability to discuss it (Gal, 2002). Aoyama and Stephen (2003) stated that statistical literacy is the ability to extract qualitative information from quantitative and make new information from qualitative and quantitative data. Bidgood et al. (2010) stated that statistical literacy requires skills in problem-solving namely, abilities in reading, writing, listening, and speaking.

Statistical literacy is defined as the ability to read, write, understand, interpret, analyze at a basic level, and interpret data through the abilities possessed and can understand and present information in the form of tables, graphs and statistical symbols in various media. Statistical literacy also plays a role in minimizing errors that occur in activities with data, so that data users can overcome the problems encountered.

Various media are used to improve the statistical literacy of students, namely electronic media, print media, internet, journals, and various other statistical literacy media. Media literacy can be used as information in statistical learning, so as to increase the abilities of students in reading and writing statistically.

Statistical literacy abilities need to be supported by good mathematical abilities. One of them is mathematical representation. The representation can be used as a tool through diagrams, graphs, tables, and symbols in expressing mathematical abilities for problem-solving, communication (learning by oral, written, drawing, graphic, and concrete concepts), and see the relationship to a mathematical problem (Bal, 2014, NCTM, 2000; Takaria & Talakua, 2018a). Ainsworth (2006) stated that representation is a way to interpret what is captured and interpreted through an image, on the screen or in words where someone can say whatever they want to say.

Mathematical representation in statistical learning is the ability to convey ideas or mathematical ideas in various forms (tables, graphs, symbols, the meaning of words, and mathematical equations) of what is seen or observed through statistical information obtained and can interpret information.

Mathematical representation in statistical literacy learning for students is important, because students can convey mathematical ideas in various forms (tables, graphs, symbols, meaning of words, and mathematical equations) from something seen/observed through statistical information obtained on various media and the student's ability to give meaning to this information (Takaria & Talakua, 2018b).

Statistical literacy and mathematical representation are two capabilities that synergize with each other and contribute to the learning process. The relationship between statistical literacy and mathematical representation can be facilitated with the collaborative problem solving (CPS) learning model.

Collaborative learning involves intellectual efforts to seek understanding, solutions, meanings, and produce a product based on mutual agreement (Van den Bossche et al., 2006).

The selection of the CPS learning model is based on the idea that this model is a form of group learning to form students into individuals who are strong in problem-solving.

The CPS learning model requires skills in problem-solving and managing differences, which are implemented through a collaborative process. The CPS learning model consists of five stages namely, engagement, exploration, transformation, presentation, and reflection (Ngeow, 1998). The CPS learning model is used to analyze the relationship between statistical literacy and mathematical representation of students as pre-service elementary school teachers.

2. METHOD

2.1. Method and Sample

This study used a correlational analysis method. The purpose of this study was to analyze the relationship between statistical literacy and mathematical representation of the abilities of students with the CPS learning model. The sample of this study was 35 students of the Elementary School Teacher Education Study Program enrolled in Statistical Education at one of the state universities in Ambon City, Maluku Province, Indonesia.

This study used a purposive sampling technique. This technique was used by researchers based on several considerations: (1) researchers expected the study to be carried out well and effectively; 2) researchers analyzed the problem according to the objectives to be achieved; and 3) students passed Mathematical Education I and II as prerequisite courses before enrolling Statistical Education.

2.2. Instrument

An instrument is a tool used to measure the variables to be studied. Therefore, research instruments need to be prepared appropriately, so that the data collected comprehensively can answer the problem and research objectives. The instruments used were statistical literacy and mathematical representation tests, and non-test instruments were in the form of observation and interview guidelines.

2.3. Data Analysis

Data analysis used a product-moment correlation. The Pearson product-moment correlation coefficient is widely used in social science research as a correlational technique between two variables (X and Y) and also in accordance with various univariate and multivariate methods (Smithson, 2000; Walker, 2017).

To analyze the feasibility of the CPS learning model, the feasibility rating model was used. Table 1 presents the feasibility rating of the CPS learning model that refers to The New Teacher Project (Takaria, 2015; Takaria & Talakua, 2018b).

Table 1. The feasibility rating of the CPS learning model

Rating	Indicator
3	all indicators are implemented
2	half or most indicators are implemented
1	more than half of the indicators are not implemented
0	all indicators are not implemented

The ratings in Table 1 were analyzed using the percentage qualifications in Table 2 adapted from (Linnusky & Wijaya, 2017)

Table 2. Percentage Qualifications of Learning Model Feasibility

Qualification	Category
$k \geq 90\%$	Very High
$80\% \leq k < 90\%$	High
$70\% \leq k < 80\%$	Fair
$60\% \leq k < 70$	Low
$k < 60\%$	Very Low

3. RESULTS AND DISCUSSION

3.1. Results

3.1.1. Correlational Analysis

The correlational analysis is a technique for looking at linear relationships between two or more variables. Based on that definition, the analysis statistically tests the relationship between statistical literacy and mathematical representation abilities with the CPS learning model.

The analysis was used to see the relationship between statistical literacy and mathematical representation. The hypothesis was "there is no relationship between statistical literacy and mathematical representation" (H_0) and the working hypothesis was (H_1) "there is a relationship between statistical literacy and mathematical representation".

Based on the classical assumption test, it was obtained that the data were not normally distributed so that the transformation of the data with square root transformation was carried out. After the data of statistical literacy and mathematical representation were transformed, the data were normally distributed (see Table 3). The homogeneity test showed that both data were homogeneous (see Table 4).

Table 3. Normality tests of statistical literacy and mathematical representation

Ability	Significance	Normality Test	
		Kolmogorov-Smirnov	Decision
Statistical literacy	(Sig.)	0.054	Normal
Mathematical representation		0.136	

Table 4. Homogeneity tests of statistical literacy and mathematical representation

Ability	Significance	Homogeneity Test	
		Levene Test	Decision
Statistical literacy	(Sig.)	0.230	Homogenous
Mathematical representation		0.164	

After the assumptions are fulfilled, a correlational test is carried out using the Pearson correlation test with the test criteria, if Sig. greater than 0.05 then H_0 is accepted and H_1 is rejected. Table 5 show the results of correlation testing.

Table 5. Correlational test of statistical literacy and mathematical representation

Pearson Correlation	Sig.	Decision
0.661	0.000	H_0 is rejected

Table 5 showed that the value of Sig (0,000) was smaller than 0.05 so that H_0 was rejected. These results conclude that there was a significant relationship between statistical literacy and mathematical representation. The Pearson Correlation value obtained was 0.661, if confirmed by the test criteria, the relationship between statistical literacy and mathematical representation was in a positive and strong relationship. This relationship showed that if students have good mathematical representation abilities, statistical literacy abilities are getting better.

Strengthening statistical literacy and mathematical representation of students was facilitated through the use of the CPS learning model and supported by a good mathematical disposition so that there would be solutions for statistical problems. Figure 1 showed the relationship between statistical literacy and mathematical representation with the CPS learning model in mathematical problem solving.

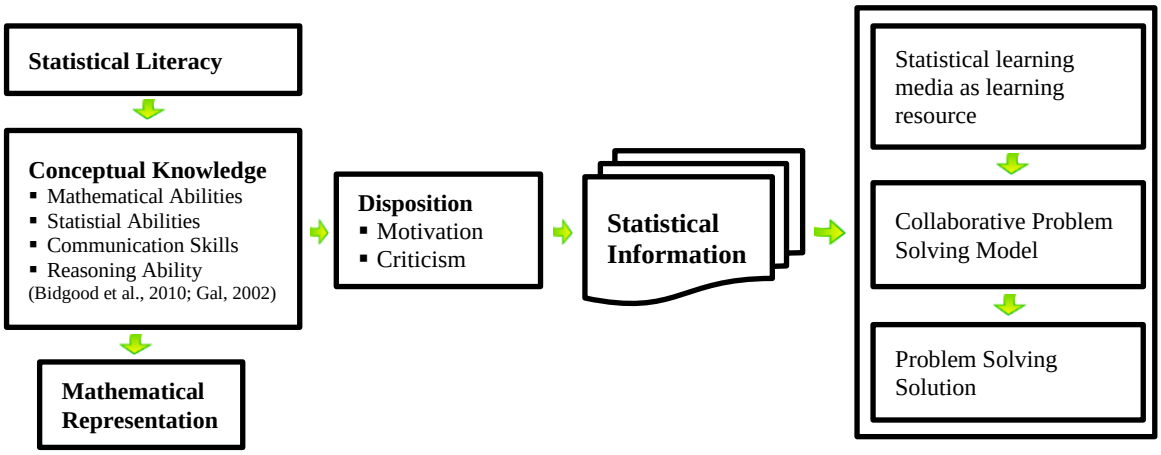

Figure 1. Relationship between statistical literacy and mathematical representation with the CPS learning model

3.1.2. Collaborative Assessment

The collaborative assessment of students was conducted by using the rubric of feasibility assessment, both in groups and individually. For group assessment, the aspects assessed were: 1) group formation (GF) with several indicators namely, independence in group formation, group division according to ideal group division criteria, and division of roles of each individual in the group; 2) idea construction and transformation (ICT) with several indicators namely; mutually building ideas, interactions, and the ability to express opinions or ideas; 3) presentation of results (PR) with several indicators namely, effective use of time, represent the results of collaboration well, and be able to answer questions from other groups; 4) group reflection (GR) with several indicators namely, group reflection on weaknesses when exploring and transforming ideas, reflection on the results of presentations, and reflection when arguing.

Based on the observation results through an observation sheet on the collaboration process to observe and record various processes in accordance with the observation

guidelines provided, the aspects of collaboration were in very good and good qualifications, with a rating that all indicators were implemented (rating-3) and half or most indicators were implemented (rating-2). Table 6 presents the rating and qualification ratings for each CPS aspect.

Table 6. Rating and qualification of CPS aspects

Aspect	CPS Group							CPS Group							Percentage of Average Qualification
	1	2	3	4	5	6	7	1	2	3	4	5	6	7	
	Rating (Rg)							Qualification (%)							
GF	3	3	3	3	3	3	3	100	100	100	100	100	100	100	100
ICT	2	3	2	2	3	3	3	75	86.7	71	75	76.7	83.3	86.7	79.2
PR	2	3	2	3	3	3	3	66.7	83.3	79.3	83.3	83.3	86.7	90	81.8
GR	3	2	3	3	3	3	3	83.3	90	86.7	86.7	90	90	90	83.3

Through the observation sheet it can be observed that the lecturer: 1) developed cognitive conflict through several inducement questions during the collaboration to explore insights from students more deeply; 2) commented and examined the results of group work for each meeting after collaborating; and 3) used assessment rubrics in the form of percentages and records of the feasibility of collaboration to assess student activities both individually and in groups.

The results of observations through the feasibility observation sheet, assessment rubric, and important notes during the collaboration process were obtained: (1) overall, the use of the CPS learning model was carried out properly and in accordance with the learning steps; (2) at the beginning of the meeting (1st), students were less flexible in collaborating; (3) only a few students were aggressive in expressing opinions (1st & 2nd meetings), other students were not having the courage in conveying ideas; (4) constructed ideas were not in accordance with the expectations of the concept of collaboration; (5) in arguing, only a few students that were proactive in defending the ideas conveyed; (6) individuals in the group had difficulty in reaching an agreement, due to various opinions that must be united (1st meeting); (7) some students tended to emphasize personal ego in the argument (1st meeting). Based on these problems, the lecturer as a facilitator, motivated and directed students in accordance with the principles and objectives of collaboration, so that the implementation of the collaboration can run well

At the next meeting, students who had the low ability and were being aggressive in conveying their ideas. Students were more flexible in collaboration, which was demonstrated through the exploration and transformation of ideas. Decision making on collaboration results was no longer a group problem, where each individual appreciated the ideas conveyed by peers. Radical obtrusiveness was also diminishing. Reflection on collaboration was very useful for students, where students individually or in groups reflected the weaknesses they had at the time of collaboration.

Reflection is a process that is needed by students when collaborating, this makes students know their weaknesses and strengths. Reflection can be in the form of attitudes when collaborating and also towards collaborated concepts. At the end of the meeting, there were several students sharing with the lecturer to discuss issues that were still being considered. Figure 2 presents the ladder of reflection between students and lecturers.

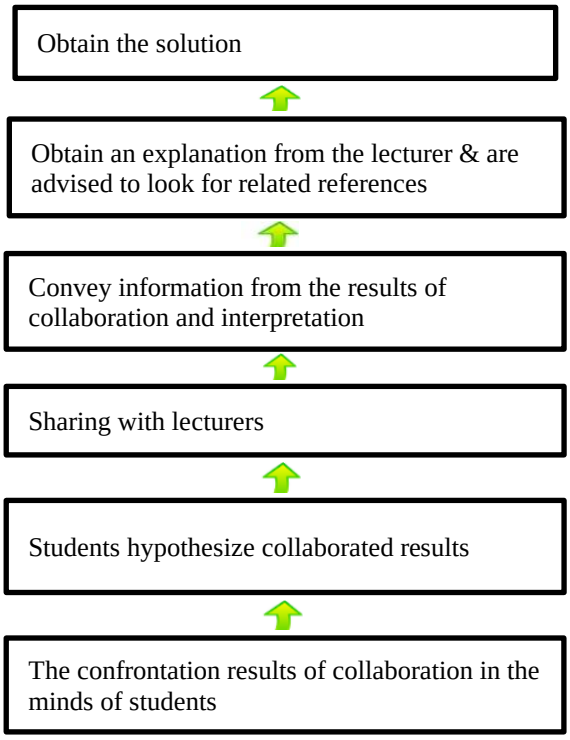

Figure 2. Ladder of reflection in students

Based on the findings, it can be explained that students who have good statistical literacy and mathematical representation abilities will drive them to become strong individuals in the field of statistics so that they have better goals and expectations in statistical problems oof society. Figure 3 shows the goals and expectations of statistical literacy and mathematical representation abilities.

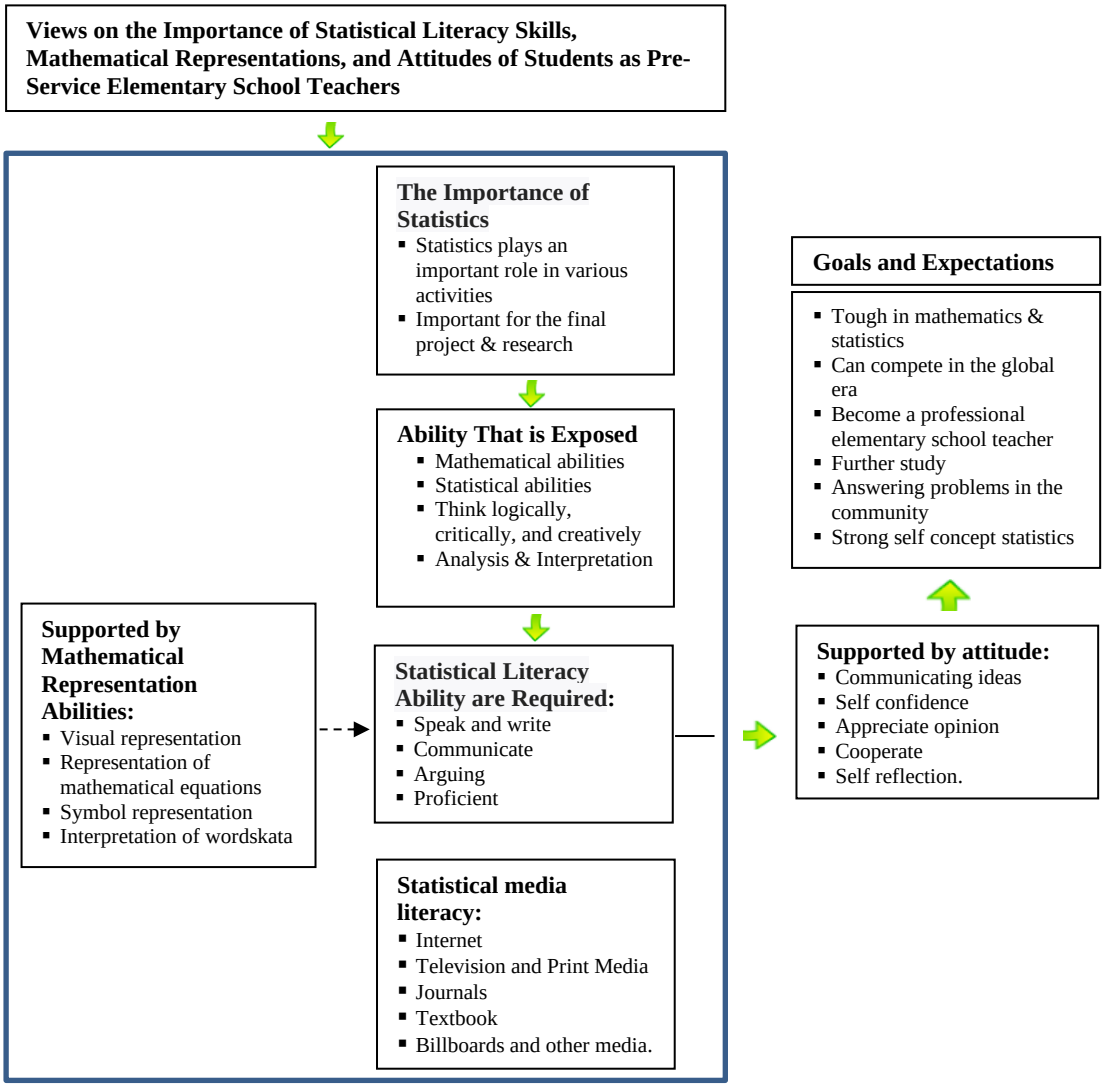

Figure 3. Goals and expectations of statistical literacy and mathematical representation abilities

3.2. Discussion

Statistical literacy is the ability students must have in critically interpreting and evaluating statistical information contained in various media. Students with good statistical literacy abilities can be actively involved in addressing statistical problems in society. To complete statistical literacy abilities, mathematical representation is needed, related to the ability to represent statistical problems in various forms through the representation of tables, graphs, mathematical equations, symbols, interpretation of words, and other mathematical representations.

The relationship between statistical literacy and mathematical representation explicitly through testing obtained a product-moment correlation index of 0.66, which was in strong and positive category. The results showed that students with good mathematical representation abilities will have an impact on good statistical literacy abilities.

Mathematical representation abilities owned by students in statistical learning has a purpose to help students in presenting creative ideas on challenging statistical problems,

namely: 1) can present information from tables into the graphical form or vice versa represent graphs in tabular form; 2) can write symbols and interpret terms; 3) use mathematical procedures correctly in solving statistical problems; 4) make arguments mathematically in contextual situations related to statistics; 5) can use variables, make equations and calculations; and 6) can use mathematical representation in other forms to solve statistical problems.

Based on Figure 1, students need to be given a reinforcement of statistical literacy abilities on the basis of strengthening mathematical knowledge, statistics, communication skills, and reasoning. Statistical literacy abilities need to be supported by mathematical representation abilities and dispositions, in this case, motivation and critical attitude. Through statistical literacy skills, students can find a variety of statistical information that can be used as learning resources and facilitated through the CPS learning model to find solutions to statistical problem-solving.

Bidgood et al. (2010) stated that the two major components needed in statistical literacy are: 1) the knowledge components namely; literacy skills, mathematical knowledge, statistical knowledge, communication skills, and reasoning; 2) disposition components namely; attitude in evaluating, constructing, recognizing, challenging and communicating ideas. Both components should be owned by students in responding to statistical information in various media

Ladder of reflection in Figure 2 shows the existence of student ideas that are not channeled and become problems for students, but in the process of reflection, the problem can be overcome. Reflection is a process that is needed by students for what they do when collaborating, this makes students know their weaknesses and strengths. According to Jonassen and Rohrer-Murphy (1999), learning activities are important activities but are not enough to interpret the learning, but must reflect the learning experience so that learning is more meaningful.

The results of identification through a series of questions to several students who performed sharing showed that students were hesitant to convey their ideas during the process of transformation and interpretation of work in front of the class. This is due to the lack of confidence in conveying the ideas.

The problems experienced by students can be sought for solutions through reinforcement and direction given by the lecturer. The steps taken are directing thought processes in constructing creative ideas through structured experiences during collaboration and students are encouraged to be more confident in conveying ideas.

According to Figure 3, it can be seen that students who have statistical literacy and mathematical representation abilities have an impact on their future prospects, where they are tough in the field of statistics, can compete, become professional teachers, further study, able to answer statistical problems in society, and has a strong statistical self-concept.

Statistical information is the main source to improve literacy and representation skills. To understand, analyze, and interpret the information, several literacy skills are required namely; speaking and writing skills, communication, argumentation, and representation skills.

Attitudes in communicating ideas and self-confidence, are the main indicators and are important for students to have. Attitudes need to be supported by abilities of mathematics, statistics, logical thinking, critical, creative, analysis and interpretation. Attitudes and abilities possessed will make students a formidable individual in finding solutions to challenging statistical problems in society.

The results of observations on the strengthening of statistical literacy and mathematical representation through the use of the CPS learning model showed that all aspects of collaboration were carried out in good and very good qualifications. The

feasibility indicator of the model was at rating-2, with criteria for half or most of the indicators that were implemented and rating-3 of all indicators were implemented. The CPS learning model was feasible because the lecturer was able to apply the model according to stages of collaborative learning.

The results of interviews with several students obtained information that, the CPS learning model was effectively used in the learning process. The problem was that collaboration time needed to be added. Another response showed that collaborating can facilitate students to understand statistical material with the help of statistical literacy learning media. By collaborating, students are trained to construct ideas individually in understanding statistical information (determining main ideas, seeing relationships and differences), and can present information in tables or graphs.

Related to anxiety, students had diverse opinions. Students stated that lectures by collaborating can minimize anxiety. Lectures on statistics with statistical literacy media for students can help them in writing a bachelor thesis, especially the ability to read graphs, tables, statistical symbols, and be able to describe them.

The results of this study expect a reformation of the statistics learning paradigm for students which is oriented towards increasing the ability to analyze and interpret data from a statistical problem through the use of statistical literacy media in learning. Statistical literacy and mathematical representations also need to be maximally developed for Elementary School students through the use of information literacy-based media that contains contextual statistical problems.

4. CONCLUSION

Based on the results, it can be concluded that there was a strong relationship between statistical literacy and mathematical representation of students as pre-service elementary school teachers facilitated through the CPS learning model. Overall, the qualification aspects of the CPS learning model had an increase in high and very high qualifications, while the feasibility of the model indicators was at rating-2 (half or most of the indicators were implemented and rating-3 (all indicators were implemented).

REFERENCES

Ainsworth, S. (2006). DeFT: A conceptual framework for considering learning with multiple representations. *Learning and instruction*, *16*(3), 183-198. https://doi.org/10.1016/j.learninstruc.2006.03.001

Aoyama, K., & Stephen, M. (2003). Graph Interpretation Aspects of Statistical Literacy: A Japanese Perspective. *Mathematics Education Research Journal*, *15*(3), 207-225. https://doi.org/10.1007/BF03217380

Bal, A. P. (2014). The examination of representations used by classroom teacher candidates in solving mathematical problems. *Educational Sciences: Theory & Practice*, *14*(6). 2349-2365. https://doi.org/10.12738/estp.2014.6.2189

Ben-Zvi, D., & Garfield, J. (2004). *The challenge of developing statistical literacy, reasoning and thinking*. Dordrecht, The Netherlands: Kluwer Academic Publishers (Springer). https://doi.org/10.1007/1-4020-2278-6

Best, J. W., & Khan, J. V. (1995). *Research in Education Seventy Edition*. Prentice Hall of India.

Bidgood, P., Hunt, N., & Jolliffe, F. (2010). *Assessment Methods in Statistical Education*. West Sussex: Willey and Sons, Publication.

Callingham, R., & Watson, J. M. (2017). The Development of Statistical Literacy at School. *Statistics Education Research Journal*, *16*(1), 181-201.

Chick, H., & Pierce, R. (2013). The Statistical Literacy Needed to Interpret School Assessment Data. *Mathematics Teacher Education and Development, 15(2),* 5-26.

Fatmanissa, N., & Sagara, R. (2017). Language Literacy And Mathematics Competence Effect Toward Word Problems Solving. *Infinity Journal*, *6*(2), 195-206. https://doi.org/10.22460/infinity.v6i2.p195-206

Gal, I. (2002). Adults' Statistical Literacy*: Meanings, Components, Responsibilities*. *International Statistical Review*, *70*(1), 1-25. https://doi.org/10.1111/j.1751-5823.2002.tb00336.x

Garfield, J. (1995). How students learn statistics. *International Statistical Review*, *63*(1), 25-34. https://doi.org/10.2307/1403775

Garfield, J., & Ahlgren, A. (1988). Diffieculties in Learning Basic Concepts in Probability and Statistics: Implications for Research. *Journal for research in mathematics Education*, *19*(1), 44-63. https://doi.org/10.2307/749110

Garfield, J., & Ben-Zvi, D. (2007). How students learn statistics revisited: A current review of research on teaching and learning statistics. *International statistical review*, *75*(3), 372-396. https://doi.org/10.1111/j.1751-5823.2007.00029.x

Hendriana, H., Putra, H. D., & Hidayat, W. (2019). How to Design Teaching Materials to Improve the Ability of Mathematical Reflective Thinking of Senior High School Students in Indonesia?. *EURASIA Journal of Mathematics, Science and Technology Education*, *15*(12), em1790. https://doi.org/10.29333/ejmste/112033

Jonassen, D. H., & Rohrer-Murphy, L. (1999). Activity theory as a framework for designing constructivist learning environments. *Educational technology research and development*, *47*(1), 61-79. https://doi.org/10.1007/BF02299477

Linnusky, I. N., & Wijaya, A. (2017). Pengembangan Perangkat Pembelajaran Dengan Pendekatan Pendidikan Matematika Realistik Pada Materi Bangun Ruang Sisi Datar Kelas VIII SMP/MTS. *Jurnal Pendidikan Matematika-S1*, *6*(1), 1-9.

Marriott, J., Davies, N., & Gibson, L. (2009). Teaching, Learning and Assessing Statistical Problem Solving. *Journal of Statistics Education*, 17(1), 1-19. https://doi.org/10.1080/10691898.2009.11889503

NCTM (2000). *Principle and Standards for School Mathematic*. Virginia: NCTM

Ngeow, K. Y. H. (1998). *Enhancing student thinking through collaborative learning*. ERIC Clearinghouse on Reading, English, and Communication, Indiana University.

Schield, M. (1999). Statistical literacy: Thinking critically about statistics. *Of Significance*, *1*(1), 15-20.

Smithson, M. J. (2000). *Statistics with confidence*: An introduction for psychologists. Thousand Oaks, CA: Sage Publications.

Takaria, J. (2015). *Peningkatan Literasi Statistis, Representasi Matematis, dan Self Concept Mahasiswa Calon Guru Sekolah Dasar melalui Model Collaborative Problem Solving*. Bandung: Universitas Pendidikan Indonesia.

Takaria, J., & Talakua, M. (2018a). The ability of statistical literacy student teacher candidate in terms of prior-ability on mathematics. *Jurnal Kependidikan: Penelitian Inovasi Pembelajaran*, *2*(2), 395-408. https://doi.org/10.21831/jk.v2i2.18768

Takaria, J. & Talakua, M. (2018b). Efektivitas Model Collaborative Problem Solving (CPS) Dalam Meningkatkan Kemampuan Representasi Matematis Mahasiswa Calon Guru Sekolah Dasar. *Jurnal Pendidikan Sekolah Dasar (JPsd)*, *4*(2), 190-203. https://doi.org/10.30870/jpsd.v4i2.3852

Tishkovskaya, S & Lancaster, A.G. (2010). Teaching Strategies To Promote Statistical Literacy: Review And Implementation. *International Association of Statistical Education (IASE).*

Van den Bossche, P., Gijselaers, W. H., Segers, M., & Kirschner, P. A. (2006). Social and cognitive factors driving teamwork in collaborative learning environments: Team learning beliefs and behaviors. *Small group research*, *37*(5), 490-521. https://doi.org/10.1177%2F1046496406292938

Verhoeven, P. (2006). Statistics education in the Netherlands and Flanders: An outline of introductory courses at Universities and Colleges. *ICOTS-7 Conference Proceedings*, 60115-2828.

Walker, D. A. (2017). JMASM 48: The Pearson Product-Moment Correlation Coefficient and Adjustment Indices: The Fisher Approximate Unbiased Estimator and the Olkin-Pratt Adjustment (SPSS). *Journal of Modern Applied Statistical Methods, 16*(2), 540-546. https://doi.org/10.22237/jmasm/1509496140

Watson, J. M. (2003). Statistical literacy at the school level: What should students know and do. *The Bulletin of The International Statistical Institute, Berlim*, *54*, 1-4.

Watson, J. M. (2006). Issues for statistical literacy in the middle school. *ICOTS-7 Conference Proceedings. IASE, Salvador (CD-Rom)*. 1-6.