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# Ideas for 21st Century Education

*Editors*

**Ade Gafar Abdullah, Ida Hamidah, Siti Aisyah,  
Ari Arifin Danuwijaya, Galuh Yuliani &  
Heli S.H. Munawaroh**

*Universitas Pendidikan Indonesia, Bandung, Indonesia*

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## Preface

Invited speakers, Distinguished Guests, Presenters, Participants, and Authors of Asian Education Symposium.

It is such an honor to have had you at the Asian Education Symposium (AES) 2016, organized by the School of Postgraduate Universitas Pendidikan Indonesia. The AES 2016 is an international refereed conference dedicated to the advancement of theories and practices in education. The AES 2016 promotes collaborative excellence between academicians and professionals in education. The conference aimed to develop a strong network of researchers and pioneers in education worldwide. The aim of AES 2016 was to provide an opportunity for academicians and professionals from various educational fields with cross-disciplinary interests to bridge the knowledge gap, promote research esteem and the evolution of pedagogy.

The AES 2016 main theme was Ideas for 21st Century Education. Education plays an important role in countries all over the globe. It will enable countries to achieve sustainable development goals by 2030. As for countries in the Asian region, education is a vehicle that can move people's mobility particularly in a time when we are welcoming the Asian Economic Community. It is without a doubt, there is a need to develop a strong collaboration and partnership among countries, both at regional and international levels. This symposium was one of our attempts to provide space for networking among academics and researchers in education. It is our hope that the symposium would contribute to the development of education as a distinct body of knowledge.

This symposium was a platform for us to disseminate and discuss our research findings. It is our expectation that the conversation from this symposium will inform policy and practices of education. It was also hoped that this symposium will open up future research on education, while at the same allowing all participants to expand their network. It is our hope that during this two-day symposium, all the participants had engaged in fruitful and meaningful discussions.

This AES 2016 proceedings contains papers that have been subjected to a double blind refereeing process. The process was conducted by academic peers with specific expertise in the key scopes and research orientation of the papers. It provides an opportunity for readers to engage with a selection of refereed papers that were presented during the symposium. The scopes of this symposium proceedings are: i) art education, ii) adult education, iii) business education, iv) course management, v) curriculum, research and development, vi) educational foundations, vii) learning/teaching methodologies and assessment, viii) global issues in education and research, ix) pedagogy, x) ubiquitous learning, and xi) other areas of education. We strongly believe that the selected papers published in the symposium proceedings will pay a significant contribution to the spread of knowledge.

We also would like to express our gratitude to all the keynote speakers from overseas who have travelled to our country to deliver and exchange their ideas. Our appreciation also goes to all the committee members who have worked hard to make this event possible. Once again, deepest gratitude for everybody's participation to the symposium as well as the proceedings.

Ade Gafar Abdullah,  
Ida Hamidah,  
Siti Aisyah,  
Ari Arifin Danuwijaya,  
Galuh Yuliani &  
Heli S.H. Munawaroh  
*Universitas Pendidikan Indonesia, Bandung, Indonesia*















achievement. Suhendri (2011) in his study found a significant influence of logical-mathematical intelligence on students' mathematics learning outcomes.

Based on the above explanation, it appears that verbal intelligence, spatial and mathematical logic does not always have a contribution to mathematical problem solving ability. This situation is thought-provoking and very much an open possibility of further research. Therefore, this study specifically attempted to test this situation.

## 2 LITERATURE REVIEW

Learning is expected to provide enough space for children to develop their full potentials (Jayantika et al., 2013). In this context, learning does not only focus on the cognitive development of students alone, but it is also directed to develop their talents and potential.

Every child has different talents; sports, art and some are gifted in the field of processing numbers (numerical). A child who is gifted in specific areas is more likely to achieve better in the field than other children. That potential intelligence is unique for each child (Murtadlo 2012).

Problem solving activity is one of the ways to develop children's intelligence. Through problem-solving experiences given to a child, a schema on facts and experiences will be established and can be used to solve the next problem (Tri Hariastuti & Saman 2007). In solving a mathematical problem, in particular, it takes specific understanding, analysis, calculation and imagination as well as verbal intelligence, logical mathematical and visual-spatial (Indragini 2010).

Studies which examine the contribution of three kinds of intelligences on learning outcomes or mathematical problem solving skills continue to emerge. One of these studies was conducted by Jayantika et al. (2013). The results indicated that spatial intelligence and logical mathematical intelligence both simultaneously and significantly contributed to mathematics achievement. These results show that spatial intelligence and logical mathematical intelligence are important factors that determine the mathematics achievement. Therefore, this study proposed that mathematics achievement can be improved by increasing the students' spatial and logical mathematical intelligence.

Another study conducted by Foster (2012) indicated that the relationships between the students' verbal skills and between their spatial skills were not as strong as would be expected. In fact, each of the two skills appeared to have stronger relationships with the other problem type. Additionally, although no strong relationships were observed

among the students' cognitive skills (i.e., verbal, spatial, and analytical skills), the strongest pairwise relationship was shown to exist between their verbal and analytical skills.

Although Campbell et al. (1995) found that vividness of visual imagery had no effect on students' problem solving success, Diezmann & Watters (2000), in Brisbane, Australia, found that spatial intelligence has a significant contribution to the students' achievement on mathematics subject. This supports the argument that logical reasoning was a greater contributor to mathematical success than vivid visual images.

From studies that have been described above, it appears that there is a lack of agreement in the role of spatial, verbal, mathematical-logic intelligences to a child's mathematical problem solving abilities. It may be caused by the different researchers' perspectives to problem-solving ability, or that there is a definition on the spatial, verbal, mathematical-logical intelligences themselves and how each intelligence correlated to each other. Therefore, this study has the possibility to provide the initial framework in interpreting the studies that have been conducted before and to find the link of each intelligence (spatial, verbal, mathematical-logical intelligences) or how each intelligence contributes to a child's ability of mathematical problem solving.

## 3 RESEARCH METHODS

### 3.1 *Research design*

The study began with a theoretical study of multiple intelligences affecting mathematics. The results would be used to build a structural model (lines) of the theoretical relationship between the variables being discussed. In addition to quantitative data, qualitative data is also used to strengthen the quantitative data interpretation. The participants of the study were 280 of class IX students of SMP Negeri 37 Surabaya, the academic year of 2016/2017.

### 3.2 *Research variables*

The variables of this study were divided into two parts, namely the independent variable (exogenous) and the dependent variable (endogenous). The independent variable is the spatial intelligence (X1), verbal intelligence (X2) and logical-mathematical intelligence (X3), while the dependent variable is the mathematical problem solving ability (Y).

### 3.3 *Research instruments*

Two types of research instruments were used in this research: (1) tests—to collect data on logical

mathematical intelligence, verbal intelligence problem-solving ability, and (2) psychological test—to measure psychological constructs of spatial intelligence.

### 3.4 Data analysis

Data collected for this research were analyzed both quantitatively and qualitatively. Quantitative analysis was done using inferential statistics which included path analysis and regression analysis. The qualitative analysis was used to supplement the information obtained from the quantitative analysis.

## 4 RESULTS AND DISCUSSION

In this research report, the variable of spatial intelligence is symbolized with  $X_1$ , verbal intelligence with  $X_2$ , logical mathematical intelligence with  $X_3$  while mathematical problem solving ability with  $Y$ . The results summary of the calculation of the four variables is presented in the Table 1.

The correlation between variables was calculated using the Pearson product moment correlation. The results are set forth in the form of a diagram as the representation of the theoretical model which is built in this study (Figure 1).

Testing of the model was done using path analysis. Trimming model of path analysis was applied in this research with an expectation to improve the structural model of path analysis itself. This was done by excluding the exogenous variables with insignificant path coefficient.

Testing is done to look at the contribution of each variable ( $X_1$  to  $Y$ ,  $X_2$  to  $Y$ ,  $X_3$  to  $Y$ ,  $X_1$  and  $X_2$  to  $Y$ ,  $X_2$  and  $X_3$  to  $Y$ ,  $X_1$  and  $X_3$  to  $Y$ , and  $X_1$ ,  $X_2$ , and  $X_3$  towards  $Y$ ). The results showed a relationship between variables  $X_1$ ,  $X_2$ , and  $X_3$  towards  $Y$  as follows.

Figure 2 shows that verbal intelligence contributes to a student's mathematical problem solving ability in the amount of approximately 29.2%. Likewise, logical mathematical intelligence

Table 1. Result summary of the calculation of the four variables of the research.

	$X_1$	$X_2$	$X_3$	$Y$
Mean	4,63	5,27	13,33	16,22
Median	5	5	13	15,5
Modus	4	6	11	15
Standard Deviation	1,33	1,57	3,56	3,86
Variance	1,78	2,49	12,68	14,92
Total	167	190	480	584

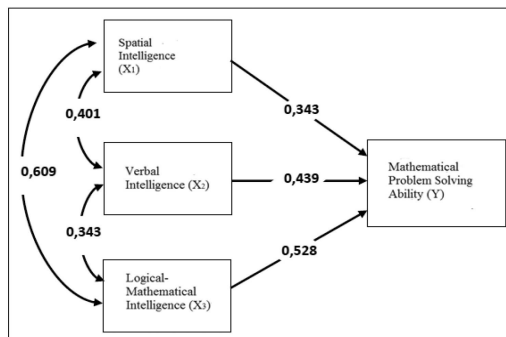


Figure 1. The coefficient correlation between variables  $X_1$ ,  $X_2$ ,  $X_3$  and  $Y$  on a theoretical.

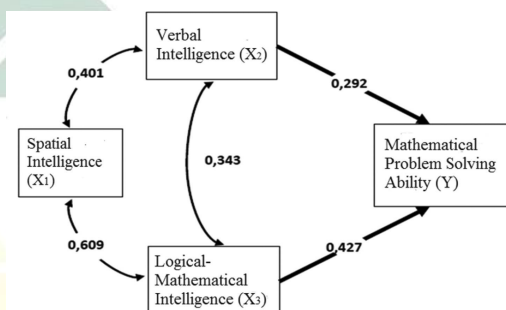


Figure 2. Line Model along with the path coefficient linking between the three kinds of intelligences and mathematics problem-solving skills.

contributes to the mathematical problem solving abilities as big as 42.2%. However, this figure also showed that spatial intelligence does not directly affect a student's ability of solving mathematical problems. Spatial intelligence contributes to the student's logical thinking ability and verbal thinking skills, which in turn affects the ability of solving mathematical problems.

These findings suggest that the stronger one's ability to think logically and the higher his verbal thinking skills, then his math problem-solving abilities would also increase. This statement indicates that a child with logical mathematical intelligence and verbal skills has the ability to manage logic and understand the context of the problems by applying logical thinking, counting, arranging pattern of relationships, and solving problems. The result is in line with Foster's (2012), who found that children with high verbal ability and logical-mathematical skills outperform other children.

A child with strong verbal intelligence and logic, according to Gunawan (2003), is able to think and devise solutions in logical sequence, have good numeracy skills and be able to think logically and orderly. On the other hand, children who have

weaker ability in math and arranging solutions in logical sequence, results in the inability to apply the concepts, principles, formulas, and units, which will eventually have an impact on their lack of ability in solving mathematical problems (Fatoke et al., 2013).

Meanwhile, the result of this research, which shows the absence of a direct impact on the ability of spatial intelligence research in mathematical problem solving, is different from the results of the study conducted Landau (1984) and Campbell, Collis & Watson (1995). The differences occurred most probably because the instrument used to measure the spatial intelligence in this research is a psychological test. This means that the spatial abilities measured did not focus dimensional spatial ability and spatial geometry as the material that is usually taught and is often found when children learn geometry in junior high school, but on how to recognize the geometrical pattern changes that exist both in 2 dimensions and 3 dimensions.

## 5 CONCLUSIONS

Based on the previous description, the following conclusions can be drawn: (1) the mathematical logical intelligence was the first determinant factor of the students' ability in solving mathematical problems (42.7%), while the second was the verbal intelligence (29.2%); and (2) when combined, the verbal and mathematical logic intelligences had direct effects to the students' ability of mathematical problem solving, while the spatial intelligence had indirect effect on the ability of mathematical problem solving.

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