Gravity: Jurnal Ilmiah Penelitian dan Pembelajaran Fisika

http://jurnal.untirta.ac.id/index.php/Gravity

ISSN: 244-515x; e-ISSN: 2528-1976

Vol. 08, No. 02, Sep 2022, Page 78-86

Analysis of student's creative thinking ability in the computation physics course

Rizka Melia Putri, Akmam*, Fatni Mufit, Silvi Yulia Sari, Rahmat Hidayat

[1]*Department of Physics Education, Universitas Negeri Padang, Indonesia*

**E-mail:* akmam_db@fmipa.unp.ac.id

(Received: 06 January 2022; Accepted: 18 September 2022; Published: 30 September 2022)

ABSTRACT

Creative thinking is crucial to support the development of students taking computational physics courses but is rarely considered, so it takes a description of students' creative thinking skills to provide alternative appropriate learning methods. The purpose is to determine the creative thinking ability of college students within the Computational Physics courses. This kind of study is descriptivewith a quantitative method. The studies populace is all college students taking courses in ComputationalPhysics for the January-June 2021 semester. The study's tool is in the form of a questionnaire. Theresearch results: Students' Creative Thinking Ability in the Computational Physics Course as a whole is 65%, based on the Problem Sensitivity indicator has a direct effect value of 0.91, the Fluency indicatoris 0.94, the Flexibility indicator is 0.96, the Originality indicator is 0.64, the Elaboration indicator is 0.69, and the Evaluation indicator 0.58.

Keywords: computational physics, creative thinking abilities.

DOI: 10.30870/gravity.v8i2.13783

INTRODUCTION

Education plays a very critical role and factor in human life because it is far a vehicle for creating quality human resources in terms of expertise and abilities in order to have the abilityto suppose critically, creatively, and openly. Thinking ability is one of the essential aspects tobe developed. Thinking is a person's mental manner that is more than just remembering and understanding (Putra, 2012). Thinking causes a person to move to expand his mind beyond the information he hears. Thinking, for example, is someone's ability to discover new solutions to a problem. One of the higher-order thinking abilities to deal with problems in science and real life is the ability to think creatively. Creativity is a learning goal rarely considered (Agustinaningsih, 2020). Students show the importance of creativity in learning with high creativity, high problem-solving abilities, and better learning achievements (Andari, 2015). The ability to suppose creatively is one of the competencies that physics students must possess.

Creative thinking is the ability to offer a spread of possible answers primarily based on the information furnished, emphasizing the variety of numbers and suitability (Nur, 2014).Creative thinking is an aggregate of thinking of logic and divergent thinking primarily based on instinct but in awareness (Wechsler, 2018). Creative thinking is often also referred to as divergent thinking. Divergent thinking has three leading indicators: fluency, flexibility, and elaboration (Guildford, 1968). Creative thinking includes thinking fluently, flexibly, original, and elaboratively (Almeida, 2008). Expertise in creative thinking as a concept production manner that emphasizes factors of fluency,flexibility, novelty, and elaboration (Hoiriyah, 2019). There is also an indicator of creative thinking, particularly sensitivity to problems, that is, the ability to understand or ignore something much less relevant so that the real problem can be identified (Darwanto, 2019). Sensitivity is the ability to discover, understand, apprehend, and reply to an assertion, state of affairs, and problem (Nurlaela & Ismiyati, 2015). Stimulus is needed to encourage awareness of a problem in response to a situation. Creative thinking, indeed, cannot be separated from the word creativity. Creativity is usually described as the potential tocreate a new product. Creative thinking is the capability to easily and flexibly discover solutions to a problem quickly and flexibly (Simanjuntak, 2019). The student's ability to think creatively allows the student to obtain many ways or alternatives to a problem, although sometimes too many ways will make it difficult for students to arrive at the final result, with many choices of ways will allow students to achieve their goals compared to students who do not have a solution to the problem. Solve the problem. Therefore, creative thinking is one of the essential things for students.

Computational Physics is essential in the physics study program at Universitas Negeri Padang. Computational physics disciplines that combine physics, numerical analysis, and computer programming have made it easier to process large and non-linear experimental data. Simulation experiments and non-linear and non-symmetrical mathematical models in computational physics can be completed with the help of numerical methods in computer programs (Said, 2015). Students in Computational Physics learning should be able toformulate the basics of numerical analysis techniques to solve physics problems algorithmically(Akmam, 2018). So that the understanding of physics, in theory, experiment, and computation, must be comparable so that numerical solutions and visualization or modeling are obtained that are appropriate for understanding physics problems. However, a common problem faced by students in solving computationally is the lack of ability to describe complex problems and analyze the general differences and similarities of a problem so that in the end, students cannot generalize problem-solving patterns (Angraini, 2019). In this case, it is related to the ability to think computationally so that scholars can think gradually and sequentially, not just be capable of programming computers. Computational thinking involves students understanding large-scale modeling systems using appropriate levels of abstraction and popularity, using mechanical inference descriptions to analyze complex data and providing supplementary computations for physics experiments on science problems. So there needs to be an encouragement in college students that affect the progress of critical and creative thinking abilities, namely college students' traits in showing critical and superior understanding; creativity in solving problems. Thinking Computational should be supported by critical thinking and thinking of creative (Akmam, 2019). The creative factor can assist explain and interpreting summary ideas, consequently allowing college students to achieve more mastery. Therefore, creative thinking is one of the essential things for students to have in studying Computational Physics.

In essence, each student's creative thinking level is different, with high,medium, and low creative thinking abilities (Agustinaningsih, 2020). This is influenced by what factors affect students' ability to think creatively. Students with high creative thinking skills tend to be more active and sensitive, try to express opinions or ideas, ask and answer various questions. Students with moderate and low creative thinking skills do notfully answer and ask questions and are afraid to issue ideas. It is essential to realize and analyzethe ability of creative thinking from college students within the Physics of Computational course to support student development, so creative thinking becomes an interestingissue among researchers. Given the significance of creative thinking abilities in supporting student development, especially in Physics learning, it is necessary to describe students' creative thinking abilities in the Computational Physics course so that knowing students' creative thinking abilities can provide alternatives in determining the correct learning method. Based on these issues, the title of this research is “Analysis of college students'creative thinking ability within the Computational Physics course.”

RESEARCH METHODS

This type of research is descriptive research with quantitative methods. Research of descriptiveaims to obtain quantitative data by describing a phenomenon in fact and as it is and has nothingto do with other variables (Sanjaya, 2013). The analysis in this study was carried out at the level of description, namely analyzing and presenting facts systematically. Therefore, this research was conducted to describe the creative thinking abilities of Universitas Negeri Padang Physics college students in the Computational Physics course.The populace on this examination were college students who took the Computational Physicscourse in January-June 2021. The sample in this examination amounted to 50 student respondents who took the Computational Physics course in January- June 2021. The instrument used inside the take a look at becomes inside the form of statements.A questionnaire is used to see the creative thinking ability of college students in the Physicsof Computational course. In the questionnaire grid, which refers to the creative thinking aspectof college students, the use of a scale of Likert, the variables to be measured are translated intovariable signs, and then those signs are used as benchmarks for compiling objects that may be in the form of statements. The questionnaire uses a Likert scale containing positive and negative statements adjusted to indicators of students' creative thinking abilities. For each item, four answer choices are provided with alternative answers, namely: Always, Often, Rarely, and Never. Questionnaires in this study were also given score levels for each alternative answer. The questionnaire instrument needs to be examined for validity to check theinstrument's feasibility to be used in the study (Sugiyono, 2012). Content material validity analysis of the Aiken V coefficient was used to check the validity of the observationsheet device. Content validity using Aiken's V coefficient (Azwar, 2012:113; Aiken, 1985:133)is obtained by applying a formula.

$$V = \sum \frac{(r_i - l_o)}{[n(c-1)]} \qquad (1)$$

Where ***r*** is the quantity given through the evaluator, ***lo*** is the bottom validity score range, ***c*** is the highest validity rating number, ***n*** is the number of experts & practitioners who carry out the assessment, and ***i*** is an integer from 1,2,3 to ***n***. The validity coefficient to find out that the instrument is in the valid category is based on the criteria in Table 1 (Retnawati, 2016)

Table 1. Valid criteria

Criteria	Description
$V \leq 0.8$	High
$0.4 \leq V < 0.8$	Medium
$V < 0.4$	Poor

The facts evaluation approach in this study is an inferential analysis based on loading factor testing with Confirmatory Factor Analysis (CFA) utilizing Lisrel 8.80. The confirmatory factor analysis (CFA) evaluation technique estimates the accuracy of the items measuring factors that have been compiled based on theoretical constructs (Hari, 2008). The CFA analysistechnique is the Structural Equation Modeling (SEM) measurement model (MM). Through CFA analysis, the factors to be estimated are (1) Problem Sensitivity, (2) Fluency, (3)Flexibility, (4) Originally, (5) Elaboration, (6) Evaluation. The theoretical framework model that has been built is then transformed into a path diagram to describe the causal courting among latent variables and determining variables. The model fit test is concerned with testing the fit between the model and data. Several criteria for a measure of fit or Goodness of Fit (GOF) can be used to carry out this step. The assessment of the level of statistical conformity with the modelis carried out through several stages, specifically: 1) complete model suitability test, 2) measurement model suitability and 3) structural model suitability (Hari, 2008).

RESULTS AND DISCUSSION

Inferential data analysis in this study used the SEM approach with the help of LISREL 8.8 software to measure how much influence each indicator had on the analyzed students' creative thinking skills. SEM is one of the multivariate statistical analyses (Rex, 2011). The SEM method contains two types of variables, namely the observed and latent variables, so research variables are arranged based on this concept. The variable of creative thinking ability (KBK) is the latent variable, and the observed variables (manifest variables) are the indicators of creative thinking ability, namely Problem Sensitivity (PS), Fluency (FU), Flexibility (FE), Originality (OR), Elaboration (EL), and Evaluation (EV). The validity of theitems that compose a construct can be seen from the t-value. Based on the evaluation results, all observed instrument indicators meet the requirements of the t-value $\geq$ 1.96. Then,to form a fit model, the indicator items are removed, then a re-estimation is carried out to see the new structural model. The path diagram of the Loading Factor re-estimation results is provided in Figure 1.

After getting the re-estimation effects, it is possible to assess the Goodness of fit criteria index. However, because the chi-square, p-value, and RMSEA values do not meet the criteria for the measure of fit or Goodness Of Fit (GOF), meaning that the model does not fit, it is necessary to do a model respecification (modification). Re-specification of the model is done if a proposed model is not a fit model (Rex, 2011). Re-specification of the model is carried out to increase the version's universal fit by decreasing the chi-square value. Re-specificationof the model is done by utilizing the information contained in the modification index in the output.

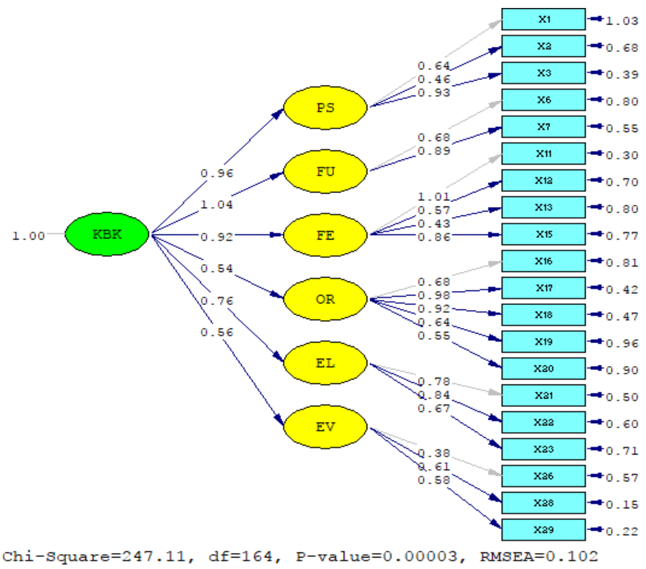

Figure 1. Path diagram of loading factor re-estimation results

The information contained in the modification index can be seen in Table 2.

Table 2. Modification indices recommend featuring an errors covariance

Between	and	Decrease in Chi-Square	New Estimate
EV	EL	14.1	0.48
X20	X19	7.9	0.17
X29	X15	13.6	0.26
X23	X6	10.15	0.35

After making modifications based on this information, a path diagram is obtained, as provided in Figure 2.

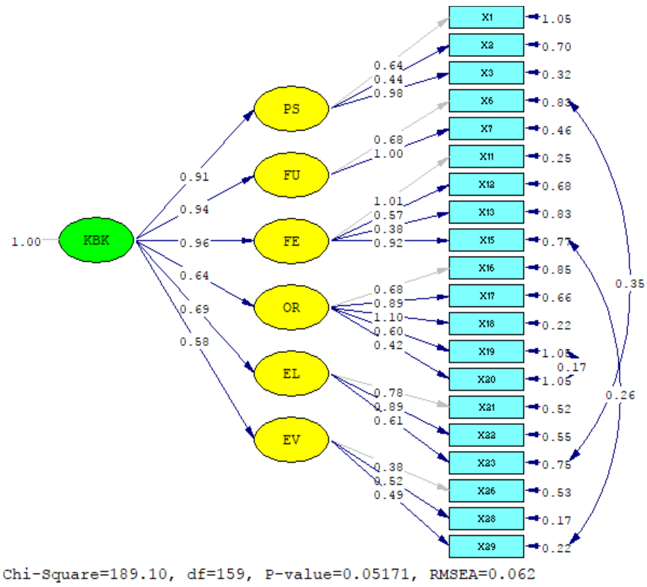

Figure 2. Loading factor model respecification

After modification, the chi-square value becomes more minor to 189.10 with a p-value that is more than desired criteria (0.0517>0.05), in order that the relatively fit of the model primarily based on the chi-square value has a good fit. The value of RMSEA becomes smaller by 0.062 (*close fit*<0.05≥*good fit≤0.08>bad fit*) with a p-value is 0.29>0.05, and the value of RMSEA is inside the 90% reliance interval for RMSEA (0.0; 0.094) in order that the RMSEA is in a reasonable degree of precision. Based totally on those outcomes, the RMSEA fit measure has a good fit. The outcomes of the close fit of the model may be visible in Table 3.

Table 3. The goodness of fit measures (GOF) after specific

GOF	Target match rate	Estimated results	Match rate
Chi-square p-value	Small value P-value ≥ 0.05	189.10 (P = 0.052)	*good fit*
Root Mean Square Error of Approximation (RMSEA) P (*close fit*)	RMSEA ≤ 0.08 P-value ≥ 0.05	0.062 0.29	*good fit*
NCP interval	Small value Narrow interval	30.10 (0.0 ; 68.70)	*good fit*
GFI	GFI ≥ 0.90	0.92	*good fit*
AGFI	AGFI ≥ 0.90	0.93	*good fit*
RMR	Standardized RMR ≤ 0.05	0.03	*good fit*
NFI	NFI ≥ 0.90	0.91	*good fit*
NNFI	NNFI ≥ 0.90	0.94	*good fit*
CFI	CFI ≥ 0.90	0.95	*good fit*
IFI	IFI ≥ 0.90	0.95	*good fit*
RFI	RFI ≥ 0.90	0.87	*Marginal fit*

Based on the SEM concept that a model can be corrected for its errors by utilizing a modification index (Rex, 2011). After the modification, the fit of the structural model was improved. The magnitude of the direct influence between latent and observed variables may be seen in the output or on the path diagram of the structural model. The coefficient of determination (R^2) measures how some distance the model's capabilityto explain variations inside the dependent variable is. A value near one way thatthe impartial variables offer the data had to expect the variation of the dependent variable. Thedirect effect analysis of the structural model of this research model is presented in Table 4.

Table 4. Direct effect structural model and coefficient of determination (R^2)

	PS	FU	*FE*	*OR*	*EL*	*EV*
(KBK)	0.91	0.94	0.96	0.64	0.69	0.58
t-value	3.47	4.26	7.04	3.32	3.97	2.50
R^2	0.85	0.86	0.87	0.46	0.49	0.25

The t-value of the factor loading meets the criteria with a t-value>1.96, which means it is significant. There was a significant change in the size of the GOFI in the structural model. The estimation results obtained by the PS variable is 0.91, the FU variable is 0.94, the FE variable is 0.96, the OR variable is 0.64, the EL variable is 0.69, and the EV variable is 0.58. The coefficient of determination R2 shows how much influence the variables PS, FU, FE, OR, EL, and EV have on the KBK variable. The estimation results obtained by the PS variable are 0.85,which means that the PS variable impacts the KBK latent variable by 85%, the FU variable is which means the FU variable impacts the KBK latent variable by 86%, the FE variable is which means the FU variable impacts the KBK variable of latent by 87 %, the OR variableis 0.46 which means the OR variable impacts the latent variable KBK by 46%, EL variable is 0.49, which means the EL variable impacts the variable of latent KBK by 49%, and the EV variable is 0.25 which means the EV variable impacts the latent variable KBK by 25%. This indicates that there may be an effective and extensive courting among the variables PS, FU, FE,OR, EL, and EV on the students' creative thinking ability (KBK) variables in the ComputationalPhysics course.

In this study, the variable that has the most significant influence on the KBK variable (Creative ThinkingAbility) is the FE (flexibility) variable, which is 0.96, and the variable that has the most negligible impact on the KBK variable is the EV (evaluation) variable, which is 0.58. The coefficient ofdetermination (R2) for the FE variable is 0.87, meaning that 87% of the FE variable affects theKBK variable. Moreover, the coefficient of determination (R2) for the EV variable is 0.25, meaning that 25% of the EV variable affects the KBK variable. The results of students' creative thinkingabilities within the Computational Physics course are presented in Table 5.

Tabel 5. Descriptive statistics of students' creative thinking ability

N	Valid	50
	Missing	0
Mean		97.50
Standart Error of Mean		1.958
Median		97.50
Mode		104
Standart Deviation		13.844
Variance		191.643
Range		59
Minimum		74
Maximum		133
Sum		4875

Based on Table 5 it saw the statistical distribution of creative thinking abilities as awhole. Based on the table, it may be described that the number of samples in the data is50 respondents, where the maximum value is 133 and the minimum is 74. The median value is97.50, the mode value is 104, the variance is 191.643, and the standard deviation is 13.844. Based on the average value obtained in the total data of 97.50, the percentage of student achievement levels on the creative thinking ability questionnaire within the Computational Physics course is 65%.

CONCLUSION

It is based totally on the results of the research and discussion which have been defined. It could beconcluded that the creative thinking ability of college students within the Computational Physics course as an entire is 65%, the variable that has the most significant influence on the KBK variable (Creative Thinking Ability) is the FE (flexibility) variable, which is equal to 0.96 andthe variable that has the slightest effect on the KBK variable is the EV (evaluation) variable, which is 0.58. The coefficient of determination (R2) for the FE variable is 0.87, meaning that 87% of the FE variable affects the KBK variable. Moreover, the coefficient of determination (R2) forthe EV variable is 0.25, meaning that 25% of the EV variable affects the KBK variable.

ACKNOWLEDGEMENT

The authors would like to thank Lembaga Penelitian dan Pengabdian Masyarakat Universitas Negeri Padang for funding this work with contract number: 858/UN35.13/LT/2021.

REFERENCES

Agustinaningsih, W. (2020). Profil kreativitas calon guru fisika dengan manajemen pembelajaran berbasis gaya belajar. *Jurnal Pendidikan Fisika*, vol.*8*(1), pp.112-125.

Aiken, L. R. (1985) Three coefficients for analyzing the reliability, and validity of ratings. Educational and psychological measurement, vol.45, pp.131-142.

Akmam, A., Anshari, R., Amir, H., Jalinus, N., & Amran, A. (2018). Influence of learning strategy of cognitive conflict on student misconception in computational physics course. In *IOPConference Series: Materials Science and Engineering*, vol.335, No.1, p.012074. IOP Publishing.

Akmam, A., Anshari, R., Jalinus, N., & Amran, A. (2019). Factors influencing the critical and creative thinking skills of college students in computational physics courses. In *Journal of Physics: Conference Series,* vol.1317, No.1, p.012172. IOP Publishing.

Almeida, L. S., Prieto, L. P., Ferrando, M., Oliveira, E., & Ferrándiz, C. (2008). Torrance test of creative thinking: the question of its construct validity. *Thinking Skills and Creativity*, vol.*3*(1), pp.53-58.

Andari, T., & Lusiana, R. (2015). Profil kreativitas mahasiswa dalam memecahkan masalah geometri pada materi sistem koordinat ruang. *JIPM (Jurnal Ilmiah Pendidikan Matematika)*, vol.*3*(2).

Angraini, L. M., Sudiarta, I. W., Qomariyah, N., Alaa, S., & Handayana, I. G. N. Y. (2019). Peningkatan kompetensi komputasi fisika dan kimia untuk mahasiswa program studi fisika fmipa universitas mataram. *SELAPARANG Jurnal Pengabdian Masyarakat Berkemajuan*, vol.*2*(2), pp.37-41

Azwar, S. (2012). Penyusunan skala psikologi edisi 2. Yogyakarta: Pustaka Pelajar

Putra, T. T. (2012). Meningkatkan kemampuan berpikir kreatif siswa dengan pembelajaran berbasis masalah. *Jurnal Pendidikan Matematika*, vol.*1*(1).

Nur, M. (2014). Berpikir kreatif. *Surabaya: Penelitian Unggulan Perguruan Tinggi UNESA*.

Wechsler, S. M., Saiz, C., Rivas, S. F., Vendramini, C. M. M., Almeida, L. S. Mundim, M. C.,& Franco, A. (2018). Creative and critical thinking: independent or overlapping components. *Thinking skills and creativity*, vol.*27*, pp.114-122.

Guilford, J. P. (1968). Creativity, intelligence, and their educational implications. *San Diego, CA: EDITS/Knapp.*

Hoiriyah, D. (2019). Kemampuan berpikir kreatif mahasiswa dalam menyelesaikan soal-soal open-ended. *Logaritma: Jurnal Ilmu-Ilmu Pendidikan Dan Sains*, vol.*7*(02), pp.201-212.

Darwanto, D. (2019). Kemampuan berpikir kreatif matematis. *Eksponen*, vol.*9*(2), pp.20-26. Nurlaela, L., & Ismayati, E. (2015). *Strategi belajar berpikir kreatif*. Yogyakarta: Ombak.

Simanjuntak, E., Hia, Y., & Manurung, N. (2019). Analisis kemampuan berpikir kreatif dalam pemecahan masalah ditinjau dari perbedaan gender. *School Education Journal PGSD FIP UNIMED*, vol.*9*(3), pp.213-220.

Said L, M. (2015). *Metode komputasi fisika*. Makassar: Alauddin University Press.

Sanjaya, Wina. 2013. *Penelitian pendidikan, jenis, metode dan prosedur*. Jakarta: Kencana Prenada Media Group.

Retnawati, H. (2016). *Analisis kuantitatif instrumen penelitian.* Yogyakarta: ParamaPublishing.

Rex, B. K. (2011). *Principles and practice of structural equation modeling: Third Edition.* New York: The Guilford Press.

Sugiyono. (2012). *Metode penelitian kuantitatif kualitatif dan R&D.* Bandung: Alfabeta.

Hari, Setyo. W. (2008). *Structural equation modeling dengan lisrel 8.8*: *konsep dan tutorial*. Yogyakarta: Graha Ilmu.