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# Analysis of Students' Attitudes and Difficulties in Studying Computational Physics

**Revi Indriani, Akmam*, Fatni Mufit, Rahmat Hidayat, and Silvi Yulia Sari**
Physics Education/Natural Sciences and Math, Universitas Negeri Padang, Indonesia
*akmam_db@fmipa.unp.ac.id

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## Abstract

Ideally, students who study Computational Physics are required to think computationally. However, student learning outcomes tend to be low. Low learning outcomes are suspected by students having difficulties. One of the causes of learning difficulties is students' attitude in responding to learning. This study aims to determine student attitudes in studying Computational Physics and the factors influencing student learning difficulties. This research is descriptive research with a quantitative approach. The population in this study were students of Physics FMIPA UNP. The sample in this research is students who take Computational Physics courses in January-June 2021. The data analysis technique used is the multivariate analysis based on factor loading testing with Confirmatory Factor Analysis (CFA) using Lisrel 8.80. The results showed that students' attitudes toward Computational Physics were good, with a percentage of student responses of 67.16%. Factors that influence learning difficulties are internal factors in the form of psychological factors in the aspect of interest (65%), motivational aspects (58%), and aspects of study habits (49%). Meanwhile, external factors do not affect students' difficulties in studying Computational Physics. Further research, it is necessary to carry out a similar analysis by taking into account other factors that are thought to influence the attitudes and difficulties of students in studying Computational Physics, both internal and external factors, so that they are better in determining the next steps to overcome student difficulties in studying Computational Physics.

**Keywords:** attitude; computational physics; learning difficulties



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## INTRODUCTION

Computational Physics is one subject that students must study in the Physics study program at Padang State University. Computational Physics aims to learn how to calculate or research Physics through computation. This process includes mathematical modelling of Physics problems, numerical algorithm design, programming and calculations, visualization, and analysis of numerical results (Fanglin, 2014). According to Mulyono and Asih, computational science is a field of science that pays attention to the preparation of mathematical models and numerical solution techniques and the use of computers to analyze and solve scientific problems (Indratno, 2019). So, Computational Physics can be studied well if students can understand various Physics problems with computer programming.

Ideally, students who study Computational Physics are required to be able to think computationally. Computational thinking is a problem-solving technique through a thinking process that involves the formulation of problems and their solutions. Computational thinking techniques include 1) decomposition is the ability to solve complex problems into more detailed problems, 2) pattern recognition is the ability to recognize general differences or similarities that will help in making predictions, 3) generalization of patterns and abstraction is the ability to filter out information that is not needed so that the solutions obtained can be used to solve similar problems, and 4) algorithm design is the ability to arrange steps in solving problems (Angraini et al., 2019). Learning outcomes from the Computational Physics course are that students can formulate the basics of numerical analysis techniques to solve physics problems algorithmically. Students who hold conceptions that are not following knowledge will have difficulty understanding computational physics learning (Akmam et al., 2018). For this reason, students must recognize and understand the concepts they are going to learn.

Research on the experiential study of Computational Physics found that students had more opportunities to use creativity in problem-solving. Other research also states that the problems that students often experience are that they often focus on the ability of students to engage with problems and the difficulty of identifying what they are facing (Caballero et al., 2012). Research on student attitudes in learning states that after considering the knowledge, students have, attitudes are related to how much students learn and how well they perform in learning (Cahill et al., 2018). Indications of this problem indicate that students have difficulty in studying Computational Physics. The value of Computational Physics for Physics FMIPA UNP students in the January-June 2019 and 2020 semesters, as many as 107 out of 188 students scored quite low. This means that more than half of students experience problems in learning success. Meanwhile, student learning success indicators are shown by an increase in the quality of student learning outcomes in higher education (Nugraheni, 2017). This shows that students experience problems in learning Computational Physics which can be in the form of attitude problems and learning difficulties experienced by students.

According to Mahrus (2013), learning difficulties include a broad understanding, namely; (1) *Learning Disorder* (learning disorder), which is a condition in which a person's learning process is disrupted due to conflicting responses. (2) *Learning* dysfunction is a condition that shows symptoms where the learning process is not functioning properly. (3) *Underachiever* (low achievement) refers to students who have intellectually above normal but relatively low learning achievement. (4) *Slow Learner* (slow learner) is a student condition in the learning process that requires more time than other students with the same intellectual potential level. (5) *Learning Disabilities* are the condition of students who are unable to learn (avoiding learning) and have low learning outcomes. Factors of learning difficulties can be identified from the factors of learning success. According to Hakim (2005), the factors that influence learning success are internal factors and external factors. Internal factors include physiological and psychological factors in the form of intelligence, talent, interests, motivation, mental health, and learning success. Meanwhile, external factors can come from parents, family, friends, educators/teachers, and the surrounding community. These factors can be seen as the learning difficulties experienced by a person due to not achieving learning success factors. Thus, the factor of learning difficulties is caused by within the person himself and the influence of factors from outside the person. These factors will interact and are interrelated, which will affect learning outcomes (Wahyudi, 2016).

Attitudes or learning styles can encourage the achievement of optimal learning outcomes. Attitude is a person's feelings and point of view towards an object accompanied by a tendency to act on that object (Dini et al., 2021). Attitudes result from receiving, carrying out, living, appreciating, and practising activities, thus giving birth to individual qualities with good attitudes (Hardiyanti et al., 2018). Attitude consists of three components, namely: 1) the cognitive component, which is related to beliefs, ideas, attitudes, and concepts, 2) the affective component, which is related to emotional problems and 3) the cognitive component, which is related to behavioural tendencies (Aswar, 2017).

A person's attitude can change or be changed. Changes in attitude in learning can be felt or known from the characteristics experienced by a person. The characteristics of changes in learning attitudes, according to Setiawati (2018), include; (1) changes occur consciously, meaning that someone who learns is aware of changes in himself consciously. For example, someone realizes the increase in knowledge, skills, and habits so that the pattern of attitudes that results in responding to something will automatically change; (2) changes in learning are continuous and functional, meaning that changes occur continuously, not statically; (3) changes in learning are positive and active. Changes in attitude in learning that are positive, meaning that someone who has increased knowledge in learning will always have a better attitude than before. Changes in attitude in active learning mean that changes occur with the efforts of the individual himself, not by himself; (4) changes in learning are not temporary but permanent or permanent; (5) changes in purposeful or directed learning; (6) change covers all aspects of attitude, meaning that a person will experience a complete change in attitudes, skills, and knowledge after learning something.

Attitudes in learning will determine the intensity of learning activities, both positive and negative attitudes. A positive learning attitude will lead to a higher intensity of activity. Lecturers as communicators play an important role in influencing students to have a positive attitude toward learning (Pujimahanani, 2013). Students who have a positive learning attitude will encourage a higher intensity of learning activities so that they are optimal in learning and are less likely to experience significant learning difficulties. Students' positive attitude toward Computational Physics can be seen in how to learn and think computationally.

Students' attitudes and learning difficulties in studying Computational Physics which leads to low student final grades, need to be overcome. Students are required to be able to think computationally. Meanwhile, it is suspected that the course lecturers conduct no detailed analysis of the causes or factors of difficulties experienced by students when studying Computational Physics. To overcome student problems in learning Computational Physics, it is necessary to know the factors causing the difficulties experienced. This study aims to find out what attitudes and factors influence students' difficulties in studying Computational Physics.

## METHOD

The research method used in this research is descriptive research with a quantitative approach. Descriptive research is research to collect information about the status of an existing symptom in the form of a symptom state according to what it was when the research was conducted without drawing conclusions that apply to the public (Arikunto, 2005). The quantitative approach measures quantitative data and objective statistics through scientific calculations derived from a sample of people or residents who are asked to answer several questions about surveys to determine the frequency and percentage of their responses (Siyoto & Sodik, 2015). This research was conducted at the Department of Physics, FMIPA, Padang State University, in January-June 2021. The research population was Physics students of FMIPA UNP who took Computational Physics courses. The research sample is students who take Computational Physics courses in the January-June 2021 semester. The number of respondents in the study is 46 students.

The research instrument used was a questionnaire. According to Arikunto (2014), to develop a good instrument, it is necessary to take several steps, namely: 1) planning in the form of formulating goals, determining variables, and variable categories, 2) writing an instrument grid; in this case, a grid-related to attitudes and difficulties. Students in studying Computational Physics, 3) writing instrument items written based on the grid that has been prepared, and 4) testing in the form of validity testing; in this case, the validity test is carried out by three validators. Instrument validity was calculated using Aiken's formula.

$$V = \frac{\sum S}{n(c-1)} \quad (1)$$

The results of category decisions are based on the *Aiken's V* Index, as shown in Table 1.

Table 1 Decision-based on Aiken's V index

| No | Interval | Category |
|---|---|---|
| 1 | ≤ 0,4 | Less Valid |
| 2 | 0,4 < V ≤ 0,8 | Valid |
| 3 | 0,8 < V | Very valid |

The research procedures are 1) the preparation stage, preparing research instruments to find out students' attitudes and learning difficulties and then testing the validity of the instrument, and 2) the implementation stage; at this stage, the data is collected through research instruments that have been validated and data is taken based on student answers to the questionnaire, 3) the completion stage, namely the stage of processing the research data using data analysis techniques, interpreting the data and then drawing conclusions from the research results.

The data analysis techniques are 1) determining the accuracy of the indicator items on the instrument based on construct theory with CFA analysis techniques assisted by lisrel *software* so that a path diagram of each indicator is obtained, 2) analyzing the model fit by evaluating the index criteria of *Goodness of Fit* and model fit. The structural influence between latent variables is the attitude and learning difficulties, 3) analyze the influence between the observed variables, namely between the attitude indicator and the attitude and between the indicators of learning difficulties and learning difficulties and the relationship between latent variables, namely attitudes and learning difficulties by paying attention to the value of the coefficient of determination (R2), 4) calculate the absolute frequency and relative frequency (%) of each attitude indicator, 5). Determining student attitude criteria from the percentage obtained based on student responses to the questionnaire,

6) determine the factors that influence learning difficulties based on the coefficient of determination ($R^2$), and 7) draw conclusions based on the analysis results of students' attitudes and difficulties in studying Computational Physics. The criteria for assessing the questionnaire are listed in Table 2.

Table 2 Questionnaire assessment criteria

| No | Scale | Criteria |
|---|---|---|
| 1 | 0-20% | Less once |
| 2 | 21-40% | Not enough |
| 3 | 41-60% | Enough |
| 4 | 61-80% | Good |
| 5 | 81-100% | Very good |

(Arikunto, 2005)

## RESULT AND DISCUSSION

The research data were obtained from student responses to the distributed questionnaires. The questionnaire used is a closed questionnaire, where students respond to the questionnaire based on the alternative answers provided. The first stage is to analyze the construct validity of attitudes and learning difficulties using the CFA analysis technique, which aims to estimate the accuracy of the indicator items that measure attitudes and learning difficulties. Through CFA analysis, the indicators to be estimated for attitude indicators (Attitudes) are; Computational Physics relationship with real-life (X1), personal interest in Computational Physics (X2), effort in learning (X3), connecting material conceptually (X4), conceptual understanding in the application (X5), general problem solving (X6), belief in problem-solving (X7), creativity in problem-solving (X8) and learning (X9). The indicators of student difficulty in studying Computational Physics (Learning Difficulty) that will be estimated are physiological factors in the form of physical conditions (Y1); psychological factors in the form of talent (Y2), interest (Y3), motivation (Y4), study habits (Y5), perception of Computational Physics (Y6); social factors in the form of relationships with parents (Y7), relationships with friends (Y8) and relationships with lecturers (Y9).

The path diagram of the student attitude and difficulty indicators is presented in Figure 1.

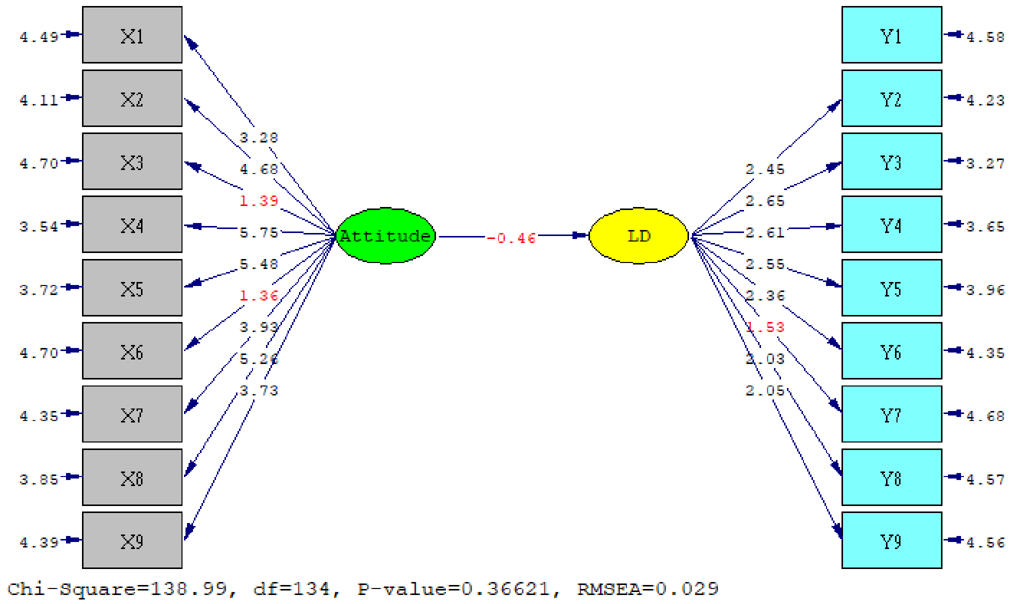


Figure 1 Loading factor path diagram with t-test

Based on the results of the factor loading path diagram analysis with the t-test in the figure, it is known that the X3, X6, and Y7 indicators do not meet the validity requirements where the t-value is < 1.96. All indicators other than indicators X3, X6, and X7 have met the validity requirements where the t-value is 1.96, as shown in Figure 2.

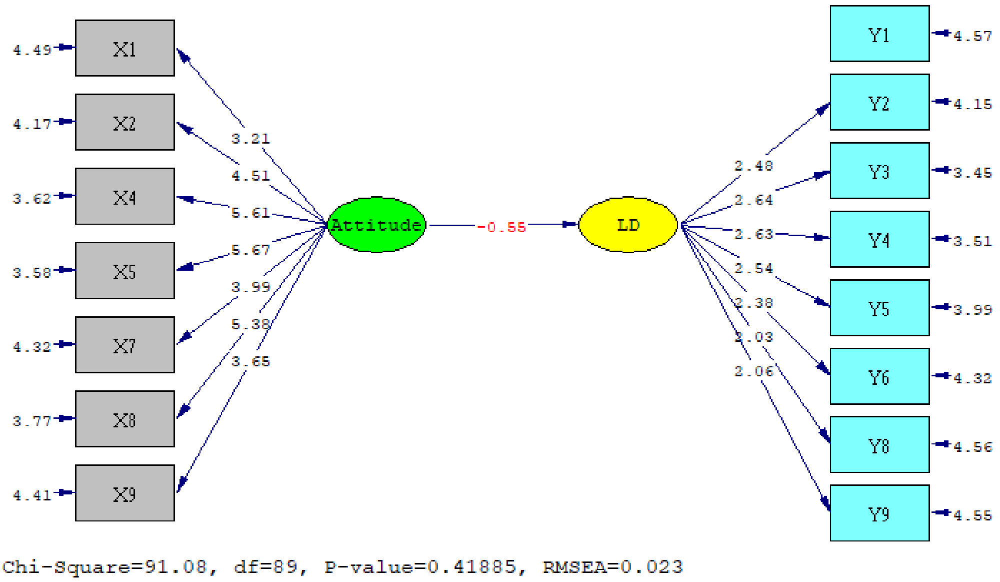


Figure 2 Loading factor path diagram after analysis by t-test

Based on the picture, it can be seen that all indicators in the picture are valid.

The second stage is the evaluation of the *Goodness of Fit* criterion index, which measures the degree of conformity between the factors analyzed with the data presented from the various types of *fit indices* used. *The goodness of fit* analyzed is presented in Table 3.

Table 3 The goodness of fit (GOF) Analysis

| **GOF size** | **Target Match Rate** | **Estimated results** | **Match Rate** |
|---|---|---|---|
| Chi-square<br>*p-value* | Small value<br>P-value ≥ 0.05 | 91.08<br>(P = 0.42) | *Good fit* |
| *Root Mean Square Error of Approximation* (RMSEA)<br>P (*close fit*) | RMSEA≤ 0.08<br>P-value ≥ 0.05 | 0.023<br>0.69 | *Good fit* |
| NCP interval | Small value<br>Narrow interval | 2.08<br>(0.0 ; 28.83) | *Good fit* |
| GFI | GFI ≥ 0.90 | 0.79 | *Marginal fit* |
| AGFI | AGFI ≥ 0.90 | 0.71 | *Marginal fit* |
| RMR | Standardized RMR ≤ 0.05 | 0.038 | *Good fit* |
| NFI | NFI ≥ 0.90 | 0.72 | *Marginal fit* |
| NNFI | NNFI ≥ 0.90 | 0.91 | *Good fit* |
| CFI | CFI ≥ 0.90 | 0.93 | *Good fit* |
| IFI | IFI ≥ 0.90 | 0.93 | *Good fit* |
| RFI | RFI ≥ 0.90 | 0.67 | *Marginal fit* |
| PGFI | PGFI ≥ 0.90 | 0.58 | *Marginal fit* |

Based on the estimation results shown in Table 3, the estimated RMSEA value is 0.023≤0.08. These results show that the model's overall fit is *good*, and the *p-value* of RMSEA is 0.69, which indicates a good overall fit of the model. The 90% *confidence interval* of RMSEA is 0.0;0.085, and the RMSEA value is within that interval, indicating that the RMSEA value is at a *good degree of precision*. The width of the 90% *confidence interval of the* NCP is (0.0; 28.83), so the NCP value obtained is in that interval, which is 2.08, so it can be concluded that the model's overall fit is not good.

Other measures that show the model's overall fit are RMR, GFI, and AGFI. The RMR value is 0.038 with a *standardized* RMR of 0.10. The model's overall fit based on RMR was taken from the *standardized* RMR value with an expected value of 0.05, so it was concluded that the overall fit of the model was not good. The estimated fit size for GFI is 0.79, and AGFI is 0.71. The criteria for the size of the fit between GFI and AGFI are 0.80≥ *marginal fit,* 0.90≤ *good fit* <1 and a value of 1 indicate *perfect fit* so that the overall fit of the *marginal fit* model is concluded. NFI, NNFI, CFI, IFI, and RFI are other GOFI measures that show the model's overall fit. The expected value of NFI, NNFI, CFI, IFI, RFI measures 0.90. The NFI size has a value of 0.72, the CFI size is 0.93, the IFI size is 0.93, and the RFI is 0.67, which indicates the size of the *marginal fit* model for NFI and RFI, *good fit* for CFI and IFI. The NNFI size is 0.91, which indicates that the model's overall fit is within the *good fit* criteria. The results of the model's overall fit can be concluded to have a *good fit*.

The third stage, the structural model fit test ( *structural model fit* ), is shown in Figure 3.

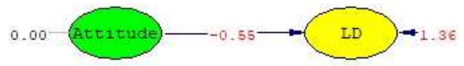


Figure 3 T-values modal structural trajectory diagram

The trajectory diagram of the structural combination of the *t-value* model shows the relationship between the latent variables. The figure shows the structural error value of the latent variable with learning difficulties (LD) of 1.36, which means that the *t-value of* LD≤2, and the structural error of the latent variable of attitude (Attitudes) of -0.55, which means the t-value of Attitudes≤2 which is shown in the figure by Red.

Structural model analysis is listed in Table 4.

Table 4 Structural model analysis

| Path | Estimasi | t-value | Conclusion |
|---|---|---|---|
| Attitudes LB⟶ | -0.10 | -0.55 | Not significant |

Based on the table, it can be seen that the t-value of the influence of the latent variable Attitudes on family planning is -0.55, which is not significant. It can be concluded that there is no influence or relationship between attitudes and learning difficulties.

The fourth stage is the analysis of the coefficient of determination to see the effect of the observed variables on the latent variables. The value of the coefficient of determination is listed in Table 5.

Table 5 Value of coefficient of determination

| Observed Variables | Latent Variables | $R^2$ | Percentage (%) |
|---|---|---|---|
| X1 | Attitudes | 0.24 | 24 |
| X2 | | 0.44 | 44 |
| X3 | | 0.049 | 4.9 |
| X4 | | 0.60 | 60 |
| X5 | | 0.56 | 56 |
| X6 | | 0.047 | 4.7 |
| X7 | | 0.33 | 33 |
| X8 | | 0.52 | 52 |

| Observed Variables | Latent Variables | $R^2$ | Percentage (%) |
|---|---|---|---|
| X9 | | 0.30 | 30 |
| Y1 | | 0.17 | 17 |
| Y2 | | 0.39 | 39 |
| Y3 | | 0.65 | 65 |
| Y4 | Learning Difficulties (LD) | 0.58 | 58 |
| Y5 | | 0.49 | 49 |
| Y6 | | 0.33 | 33 |
| Y7 | | 0.080 | 8 |
| Y8 | | 0.18 | 18 |
| Y9 | | 0.19 | 19 |

Based on Table 5, students have a positive attitude in studying Computational Physics which includes the attitude components as the attitude component mentioned by Aswar (2017), namely the components of cognition, affection and conation. Cognitive components (in this case are indicators X1, X4 and X5) relate to students' knowledge or beliefs about Computational Physics learning materials. The affective component (in this case found in indicators X2 and X9) relates to whether or not they enjoy reading/studying Computational Physics books or the willingness to study and apply Computational Physics material. The conation component (in this case, the indicators X7 and X8) relates to student efforts in deepening Computational Physics Lectures.

Factors that have less or little effect on students' difficulties in studying Computational Physics are social factors on external factors in the form of relationships with friends and methods and ways of teaching lecturers. In this case, students responded that the methods and methods of teaching lecturers in Computational Physics lectures had very little effect on learning difficulties, which means that teaching lecturers in Computational Physics lectures could be said to be good (no problems). Students' learning difficulties which are dominantly influenced by psychological factors on internal factors, indicate that the students themselves cause the problems (learning difficulties) experienced by students (in this case, on the aspects of interest, motivation and study habits). Therefore, to overcome student learning difficulties, it must be grown from within the students themselves related to interest, motivation and study habits in studying Computational Physics.

The influence between latent variables through the regression equation of the latent variables in the model built, namely,

$$\mathbf{KB = -0.081*Attitudes}$$

The *t-value* of the structural equation model is -0.55. This result shows that the parameter value is not statistically significant because ( *t-value* of 1.96) with a standard error of 0.99. The coefficient of determination ($R^2$) which shows the relationship or influence of variable Attitudes against LB is 0.0065 (0.65%) means very little relationship or influence of variables Attitudes with variable LD.

The fifth stage is the analysis of student attitudes toward Computational Physics based on frequency. The percentage of students' attitudes towards computational physics from each indicator is listed in Table 6.

Table 6 Percentage of students' attitudes towards computational physics from each indicator

| No | Indicator | N | % | Category |
|---|---|---|---|---|
| 1 | Computational Physics relationship with real life | 46 | 69.84% | Good |
| 2 | Personal interest in Computational Physics | 46 | 67.01% | Good |
| 3 | Effort in learning | 46 | 70.81% | Good |
| 4 | Connecting material conceptually | 46 | 70.76% | Good |

| No | Indicator | N | % | Category |
|---|---|---|---|---|
| 5 | Conceptual understanding in application | 46 | 68.42% | Good |
| 6 | General troubleshooting | 46 | 61.79% | Good |
| 7 | Confidence in problem-solving | 46 | 63.97% | Good |
| 8 | Creativity in solving problems | 46 | 59.29% | Pretty good |
| 9 | How to learn | 46 | 72.55% | Good |
| Average percentage | | | 67.16% | Good |

Based on Table 6, the percentage of students' attitudes towards Computational Physics is categorized based on the questionnaire assessment criteria in Table 2; overall, it can be averaged so that the percentage of students' attitudes towards Computational Physics is 67.16%, with the category of students having a good attitude (positive) towards Computational Physics.

Attitudes or learning styles can encourage the achievement of optimal learning outcomes. The role of attitude will determine what a person sees and how to see it (Dimyanti, 2012). Attitude is the ability to assess something in the form of an attitude of accepting, refusing or ignoring (Jati, 2013). Attitudes in learning will determine the intensity of learning activities, both positive and negative attitudes. A positive learning attitude will lead to a higher intensity of activity. Students who have a positive learning attitude will encourage a higher intensity of learning activities so that they are optimal in learning and are less likely to experience significant learning difficulties.

## CONCLUSION

Based on the research conducted and the discussion, it can be concluded that students' attitudes toward Computational Physics are good. The factors that influence students' difficulties in studying Computational Physics are internal factors in the form of psychological factors in motivation and study habits. Meanwhile, external factors in student relationships with parents, relationships with friends, and methods and ways of teaching lecturers do not affect students' difficulties in studying Computational Physics. Students must grow from within themselves related to interest, motivation, study habits and self-confidence in doing exercises and assignments in Computational Physics learning and practising creativity skills in solving Computational Physics problems to grow the student's intelligence.

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