The effect of remediation on reducing misconception: a meta-analysis of student thesis on physics education

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Abstract. The purpose of this study is to compare the effects of various remediation practices in reducing the number of student misconceptions on physics concepts. This research synthesizes 68 thesis undergraduate students of physics education which are published in Tanjungpura University library 2009-2016 period. In this study, the guidance in the form of checklist in conducting the study arranged to facilitate the understanding and assessment of the scientific work. Based on the analysis result, the average of effect size of all the synthesized thesis is 1.13. There are six forms of remedial misconceptions performed by physics education students, such as re-learning, feedback, integration of remediation in learning, physical activity, utilization of other learning resources and interviews. In addition, sampling techniques and test reliability were have contributed to the effect size of the study. Therefore, it is expected that the results of this study can be considered in preparing the remediation of misconceptions on physics learning in the future.

1. Introduction
A study that summarizes the results of research on the effects of remedial learning activities on reducing the number of misconceptions is important to implement as it will lead to an appropriate remediation program policy in physics learning. So far, remedial programs mentioned in the curriculum is an alternative activity to improve student score. While remediation is a corrective activity directed to overcome student learning difficulties by improving or clarifying the frame of mind so that students who have not achieved mastery can master the material completely [1].

Physical learning is generally considered difficult for most students. It happened because they experienced misconception or misunderstanding with the correct concept they in physics learning. Therefore, students un-abled solve the problems related to physics, in fact it is because students do not understand the concepts in learning physics. Handling slow students and learning difficulties or learning disabilities can be dealt with remedial activities by covering several things: 1) things that affect learning failure; 2) predict whether or not learning failure is overcome; 3) What alternative improvement activities can be used to overcome learning difficulties [2].

Since 2009, Physics Education Study Program of FKIP Untan has a remedy of misconception remediation research for students as a condition of completing the final task. It aims to contribute to innovative thinking in helping to overcome students who have misconceptions on the subject of physics. But the results of these studies are usually stored in libraries or not utilized to the fullest. So it’s no wonder most researchers feel incapable of following the very rapid development of direct research reports except on narrow branches of science or rely on the available summary [3].
Meta-analytical methods and meta-ethnographic methods are methods developed for reviewing the results. Meta-analysis method is a form of quantitative summary that examines the results of the study statistically. While the meta-ethnography method is a form of qualitative summary. Meta-analysis methods are considered to be more objective (focus on available data) so that the results can be more accurate and credible [3]. According to Littell, Corral & Pillai [4] that one of the uses of meta-analysis is to analyze the differences in results between studies. The results from the original study are usually converted to one or more common metrics, called the Effect Size.

This study is a preliminary study in developing a remedial program that can be implemented by integrating in physics learning. The results of this study are expected to provide information about the effectiveness of the implementation of remedies misconception by physics education students in West Kalimantan. The meta-analysis and secondary analysis studies have been conducted in a shorter period so that the summary does not provide a broader picture to the students or further researchers. Therefore, the purpose of this study is to summarize remediation activities that have been carried out in FKIP Untan on the decrease in the number of misconceptions of students in western Kalimantan and help the problem, namely by knowing the forms of remediation activities undertaken and analyze the influence of research characteristics with the results of remediation implementation, and calculate the highest effect size of remediation activities.

2. Methods

This research used the meta-analysis steps by Sutrisno, Kresnadi and kartono [1] with modification. The documentary technique in this study served to collect selectively the materials used in the theoretical framework [5]. With the data collection tool in the form of a list of reading tables with procedure.

A student thesis conducted the following Tanjungpura University (Untan) Library database which focus the implementation of remediation in 2009 – 2016 year period. It produced 133 studies, out of these, 68 studies were retained for use in this meta-analysis. The selected sample is based on thesis that meets the criteria of observation sheet. Some criteria taken for choosing the sample of this studies. The following criteria for inclusion were set:

- The student thesis were published between 2009-2016
- Focus of thesis was remediation of decreasing the number of misconception in physics
- Definition of remediation written in operational definition.

![Figure 1. Flow diagram of inclusion and exclusion of studies.](image-url)
3. Results and Discussion

Study of effect size related to the magnitude of the effect caused by the treatment [5]. The other reason was to have significant measure in evaluating research [6]. This research as pre-liminary research to understand how the implementation of remediation in west Kalimantan which conducted by student. The number of student studies that match the criteria of observation sheet with the average effect size of the low category amounted 11. The average category of effect size was numbered 20 and high category amounted to 37. The summary results show that the effectiveness of remedial activities of student misconception Physics Education in 2009/2016 year period is high. Thus is the following discussion the overall and differential intervention effects are presented. The overall or mean effect size was 1.13 with confidence interval was 0.27 and 2.1. The forms of remediation activity undertaken and analyzed the influence of research characteristic with result of remediation implementation, and calculate the value of the highest effect size form of remediation activity.

3.1. Forms of remediation activities

The form of remediation activities reported 6 types, namely physics activity, re-teaching, feedback, interviews, integration remediation on physics learning and other source. Presented the number of theses based on the forms of remediation activities in Table 1 below:

| No. Analysis | re-teaching | Feedback | Interview | Physics Activity | Integration | Other source |
|--------------|-------------|----------|-----------|------------------|-------------|--------------|
| 1            | 55 (81%)    | 1 (6%)   | 1 (0.001%)| 2 (3%)           | 2 (3%)      | 4 (0.84%)    |

Table 1 shows that the form of remediation activities in the form of re-learning is mostly done by students, with a total of 55 studies. Feedback and interview remediation activities are only one thesis. Integrated remediation amount to two studies and other source was 4 studies. Remedial activity in the form of re-learning is the most widely implemented Physics Education student FKIP Untan is the use of teaching materials / reading. Refutation text and mind mapping are mostly used in re-learning with the use of models / methods / strategies with teaching materials.

3.2. Effect Size Forms of Remediation Activities

Grouping of remediation activity forms obtained value effect size of each form of remediation activity by averaging ES. The average recapitulation of ES forms of remediation activity is presented in Table 2.

| No. Analysis | Forms of remediation activities |
|--------------|---------------------------------|
|              | re-teaching | Feedback | Interview | Physics Activity | Integration | Other source |
| 1            | 55          | 1        | 1         | 2                 | 2           | 4           |
| 2            | 1.15        | 1.06     | 0.0001    | 1.42              | 1.73        | 0.84        |

Table 3 presents the number of theses and the average form of remediation, showing that the remediation form that has the highest effect size is integration with = 1.73 (n = 2). The form of remedial in the form of re-teaching has 1.15 (n = 55), the feedback has 1.06 (n thesis = 1) and the interview has the lowest effect size value on 0.0001 (n = 1), form with physics activity is 1.42 dan iether source 0.84.

These findings indicate that the remediation of the greatest value of its effect size is the remediation activity that is integrated into the learning of physics. This can be recommended as a consideration that improvement activities during physics learning can help students to overcome learning difficulties.
3.3. Effect of Research Characteristics and Implementation of Remediation

The characteristics of the remediation studies that have been undertaken and their implementation are seen to be influenced by analyzing the assumptions of some statistical tests. The review is done on the large price effect size in each study of research characteristics and research methods used during remediation implementation. The following Table 3 presents the recapitulation effect of research characteristics and effect size value.

| No | Variables                  | Statistic Test     | Results   |
|----|----------------------------|--------------------|-----------|
| 1  | Gender                     | U Mann Whitney     | Not significant |
| 2  | Location                   | U Mann Whitney     | Not significant |
| 3  | School Level               | Kruskall Wallis H  | Not significant |
| 4  | Physics Content            | Kruskall Wallis H  | Not significant |
| 5  | Number of sample           | Spearman Rank      | Not significant |
| 6  | The sampling technique     | Kruskall Wallis H  | Significant |
| 7  | Realiability coefficient   | Spearman Rank      | Significant |
| 8  | Number of class            | Kruskall Wallis H  | Not significant |
| 9  | Learning media/tool        | Kruskall Wallis H  | Not significant |
| 10 | Test form                  | Kruskall Wallis H  | Not significant |
| 11 | GPA of researcher          | Spearman Rank      | Not significant |

The results of the data show that of 11 characteristics of the study do not all have a significant relationship to the effect size. From result of analysis, according to characteristic of researcher, in this case gender and IPK researcher did not show significant relation to ES. While according to the characteristics of research methods, sampling techniques and reliability coefficients have a significant relationship. Basically, not all students experience misconceptions or misconceptions of the correct concept. The remediation is for the students who experience the concept mistake (misconception) and have not yet reached the completeness of study so that need to pay attention to the way of sampling so that student which become target of remedial teaching is student which show the result of study which is lower below the average value reached by the group [4]. The reliability coefficient indicates that the testing of the research instrument provides a belief in the extent to which measurement results can be trusted. Therefore, if repeated measurements of the same group of subjects have been repeated, they will result in relatively similar measurements [5].

4. Conclusion

Based on the results of research and discussion can be concluded in general that the implementation of remediation can be said to be effective with the average that is classified as high. The forms of remediation activities are re-teaching, feedback, interview, integration remediation on physics learning, other source, and physics activity. Results of statistical analysis, research characteristic (studies) which is sampling method, and coefficient of reliability have significant influence to the implementation of remediation. While gender, location of study, level of school, sample size, number of classes, physics materials, tools / learning media and test form have no significant effect on the implementation of remediation. The remediation form with the highest average is integration (n = 2, test= 1.73).

5. References

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