Development of pocket book on electron configuration materials to increase student motivation and learning outcomes

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Abstract. This study aims to develop a pocket book on electron configuration material and observe the influence of the pocket book on improving student’s learning outcomes, motivation and response. The sample of this study was class X IPA students of Inshafuddin (X IPA-1, X IPA-2, and X IPA-3), with total sampling technique. This research is an ADDIE model development research. Pocket book implementation uses the design of the one group pretest posttest. Data was collected through validation sheets, test questions, learning motivation questionnaires and student response questionnaires. The analysis was carried out using percentage, \(N\)-gain and \(t\) test. The results of this study indicate that pocket books that are developed properly are used with the category "very good" based on the assessment of expert validators and teachers. The results of applying pocket book in class X IPA-1, X IPA-2, and X IPA-3 indicate that (1) pocket books can improve student learning outcomes, (2) pocket books can improve student learning motivation, (3) pocket books get good responses from students.

1. Introduction
The chemical learning process is expected to be oriented to process skills, where students can search for information independently, while the teacher as a facilitator. Therefore, the learning process must apply appropriate methods and media, so that students can arouse interest in chemistry lessons. For this reason, improvements need to be made in the chemistry learning process, especially the use of media to achieve the desired goals.

Based on observations of class X IPA there are several causes of low learning outcomes in electron configuration material, namely low student motivation, difficulty learning the material and lack of facilities and infrastructure, especially learning media. As a boarding school, high school students in Inshafuddin have high motivation to study religion, so they have an advantage in the field of Tahfizh Quran and the ability to speak Arabic, but students have low chemistry learning motivation. This is indicated by several things, namely not paying attention to the teacher when explaining the material, talking to friends when the learning process takes place, often going out of class, and the low interest in reading, especially text books. The text book presents material with a long description, therefore students feel bored and have no interest in reading. The learning process also shows that there are still many students who do not understand the rules for writing electron configurations, so students experience difficulties when studying chemical bonds, because to study chemical bonds students must understand the concept of writing electron configurations first. In addition, learning is also not equipped with
media. This makes it difficult for students to study chemical material, even though media can help students to learn material and increase motivation to learn.

Media has an important role in the chemistry learning process, such as being able to facilitate students to understand the concepts learned, as reported by [1] that the media can clarify the topic being taught. [2] also reports that media can facilitate students to learn difficult concepts. [3] also report that media can help students learn teaching material so that an increase in understanding of concepts. In addition, the media can also increase student learning motivation, as stated by [4] that the application of media in the teaching and learning process can generate learning motivation in students.

Motivation greatly influences student learning outcomes, as stated by [5] that students who have high learning motivation, will get higher learning outcomes. [6] also revealed that motivation has a positive influence on student learning achievement. [7] also reports that there are differences in achievement of students with low and high motivation.

The learning outcomes of Inshafuddin High School students on chemical material are still far from expectations, especially in electron configuration material studied by class X students. This can be seen based on the UN and replication data in the last three years. The percentage of student achievement based on UN data for the 2015/2016, 2016/2017, and 2017/2018 academic year at the school level (Inshafuddin High School) is 61.11; 50.00; and 33.33, Banda Aceh city 42.66; 55.73; and 47.27, and Aceh province 47.27; 53.09; and 46.66 [8,9,10]. The percentage of students who did not complete based on the 2015/2016, 2016/2017 and 2017/2018 academic year replication data were 60, 50, and 60 respectively.

Some alternatives have succeeded in increasing the learning outcomes of high school students are interactive multimedia and pocket book, as reported by [11] that effective interactive multimedia is applied to improve student learning outcomes. [12] also revealed that the use of pocket books can improve student learning outcomes. The media that have succeeded in increasing motivation are android and pocket book based media. [13] also reports that student learning outcomes can be improved through the implementation of android based learning media. [14] also report that the use of pocket books can increase student learning motivation by 5.68%.

One alternative solution to overcome the problem of low motivation and student learning outcomes in electron configuration material is pocket book use. Pocket books that are presented in a language that is easily understood by students, not too monotonous, and the presentation of short and clear material and an attractive appearance can arouse learning motivation, so students are not bored in learning. The practical use of pocket books can arouse students’ desire to learn not only limited in the classroom. Students can repeat the material themselves when they are out of class, because pocket books have advantages, namely their small sizes so that they are easy to carry around and present material that is short, solid, and clear. This can help students to improve understanding of concepts about the material being studied. [15] reported that the use of pocket book can significantly improve student learning outcomes. [16] also revealed that the use of pocket books can improve students knowledge and skills.

Based on the description above, pocket book was developed which aims to improve student motivation and learning outcomes in electron configuration material in class X of SMA Inshafuddin Banda Aceh.

2. Methods
The population in this study were all students of class X IPA science in SMA Inshafuddin. The sample selection is done by total sampling technique, namely sampling by taking all members of the population as samples. The samples chosen in this study were students of class X IPA-1, X IPA-2, and X IPA-3 which amounted to 54 students.

Pocket books were validated by material, media and language experts, and chemistry teachers at SMA Inshafuddin. The research instruments used validation sheets, test questions, learning motivation questionnaires, and response questionnaires. The analysis of validation data by validators was analyzed using the percentage formula.
The results of the pre-test and post-test were analyzed using the N-gain test to determine the improvement in learning outcomes after the learning process was carried out. According to [17] the N-gain formula is:

$$N\text{-gain} = \frac{\text{postest score} - \text{pretest score}}{\text{maximum score} - \text{pretest score}}$$ (1)

The data obtained must be normally distributed. The normality test in this study used the Lilifors test using Ms. Excel. The Lilifors test was performed data significant level $\alpha = 0.05$. If the significance obtained is greater than ($\alpha = 0.05$) then the data is normally distributed, whereas if the significance obtained is smaller than ($\alpha = 0.05$) then the data is abnormally distributed [18]. Questionnaire of learning motivation and student responses are analyzed using the same steps as validation data analysis. The researcher used a rating scale for reference to assess the data produced from the questionnaire. The scale of student response assessment is the same as the validation rating scale, which is as presented in Table 1.

The test is used to determine the effectiveness of pocket books on student motivation and learning outcomes based on the results of the pretest and posttest. [19] the t-test formula used is:

$$t = \frac{M_d}{\sqrt{\frac{\sum X_d^2}{N(N-1)}}}$$ (2)

Where 
$X_d$ = Mean between pretest and postest
$\sum X_d^2$ = Total squared deviation
$N$ = Total sample

Hypothesis testing uses a significant level ($\alpha = 0.05$). The testing criteria used are if $t_{\text{count}} < t_{\text{table}}$, then $H_0$ is accepted, this indicates that pocket book cannot increase motivation and student learning outcomes, conversely if $t_{\text{count}} \geq t_{\text{table}}$ $H_0$ is rejected, this indicates that pocket book can increase student motivation and learning outcomes.

3. Result and discussion

3.1 Pocket book development description

3.1.1. Analysis

Based on observations in SMA Inshafuddin Banda Aceh in the learning process, students who do not understand the rules for writing electron configurations, so students experience difficulties when studying chemical bonds, because to study chemical bonds students must understand the concept of writing electron configurations first. This is because chemistry learning does not use other media that make it easier for students to understand chemical material. Based on the results of interviews with learning chemistry teachers using only Class X chemistry textbooks for SMA/MA by Sudarmo, but not using media that can help students understand the material being taught. Media plays an important role in increasing student motivation and learning outcomes, as revealed by [20] that learning media can improve student learning outcomes and motivate students to learn.

The results of the observation also showed a lack of interest in students reading books, especially textbooks. The textbook presents material with a long description that makes students tired of reading, as stated by [21] that books have an important role for students as a source of information, but students lack interest in reading when thick books are less interesting.
3.1.2. Design

The design phase is carried out in the initial design of pocket books that want to be developed based on the analysis of the needs that have been carried out.

Pocket books are designed in practical sizes, so they are easy to carry everywhere and can be read anytime. Cover is designed to use attractive colors so that it can encourage students to read. The language used is easy to understand and the presentation of material is short so that it can help students to more easily understand the material presented. Display is also designed to be more attractive, to increase the interest of students in learning the material, so that it can generate motivation, as stated by [22] that learning media can foster motivation and interest in student learning so that learning effectiveness can be achieved. Pocket book design is presented in Figure 1.

![Pocket book design](image)

**Figure 1.** Design of pocket book

3.1.3. Development

In the development phase, the pocket book that was designed was then validated by 3 experts, namely material experts, media experts, and linguists. Based on the results of the validation from material experts, media, and language each of them obtained a percentage of 91, 95, and 89 which shows that overall pocket books that have been developed are included in the category "very good", so it is feasible to be used in learning. This is in accordance with what was expressed by [23] that the percentage of
pocket book assessments by material experts and media experts were 90 and 95 respectively in the "very good" category. Research by [24] also showed that pocket books developed obtained scores from linguists by 58 in the "good" category.

Based on the results of the validation from the teacher obtained a percentage of 82% with the category "very good", so that pocket book is suitable for use in learning. This is in accordance with that reported by [25] that based on the teacher's assessment, the picture media in the form of pocket books is suitable for use in schools. The development of pocket book is presented in Figure 2.

![Figure 2. Development of pocket book](image-url)

3.1.4. Implementation

The implementation phase is to carry out the learning process by implementing pocket books that have been developed. Implementation is done by replacing the teacher on electron configuration material which aims to determine the increase in learning outcomes, motivation and student responses to the product being developed.
3.1.5. Evaluation

The evaluation phase is the final stage of the ADDIE model. This stage analyzes the feasibility and effectiveness of pocket books. Evaluation can be carried out in each process and at the end of development activities. Evaluation carried out in the development process is the result of validation from expert validators and chemistry teachers, while evaluations carried out at the end of the development activities are the results of student responses.

The pocket book that has been developed is validated to material experts, media, and language each of them obtained a percentage of 91, 95, and 89. The revised pocket book was validated by two chemistry teachers. Based on the results of the validation from the teacher obtained a percentage of 82%. After being revised again, then pocket books are applied at school to see the effect on student learning outcomes, motivation, and response. The pretest results obtained an average of 35.46, while the posttest results increased by 72.04. The results of student learning motivation before learning obtained an average of 56% while the results after learning increased by 88%. The response data shows that pocket books get responses from students by 80%.

3.2. Data on Student's Learning Outcomes

To obtain answers whether pocket book can improve student learning outcomes, it is necessary to analyze the research data. Increasing student learning outcomes is obtained based on the difference in the value of the pretest and posttest or by calculating the value of \( N\)-gain, then determined the \( N\)-gain category of students, namely low, medium, and high. Improved student learning outcomes are presented in Figure 3.

Based on Figure 3, in general there is an increase in student learning outcomes before and after learning. The pretest results obtained an average of 35.46, while the posttest results increased by 72.04 with an average \( N\)-gain of 0.54. Data normality test is used to determine whether the pre-test and post-test results are normally distributed or not, because the data used must be normally distributed. The normality test was carried out using the Excel program with the Lilifors test at a significant level of 0.05. The results of the normality test are presented in Table 1.

![Image of a bar chart showing learning outcome improvement](image-url)

**Figure 3.** Students’ learning outcomes improvement

| Data   | \( L_{\text{max}} \) | \( L_{\text{table}} \) | Conclusion |
|--------|----------------------|---------------------|------------|
| Pretest| 0.09                 | 0.12                | Normal     |
| Posttest| 0.08                | 0.12                | Normal     |

Table 1. Data on the normality test of student learning outcomes
Based on Table 1 shows that \( H_0 \) is accepted so that pretest and post-test data are normally distributed. To find out the improvement in learning outcomes, the hypothesis was tested using the t-test. The results of the analysis of learning outcomes using the t test obtained \( t_{count} \) of 13.553, while the table with a confidence level of 0.05, the degree of freedom from 54-1 = 53 is 1.671. This shows that \( t_{count} > t_{table} \) so that the hypothesis that reads the use of pocket book can improve student learning outcomes "accepted". This happens because pocket books can make active students learn so that learning outcomes can increase. Based on the results of observations, it was shown that students actively conducted group discussion activities using pocket books and satisfying presentation results. Pocket book is a medium in learning. This shows that learning media can improve student learning outcomes, as revealed by [26] that learning media has a positive influence on student learning outcomes. [27] also shows that the media developed successfully improves student learning outcomes.

### 3.3. Data on student’s motivation

The increased of student motivation was obtained based on the difference in value before and after learning. Data on the results of student learning motivation can be seen in Table 2.

| Data                | Student Learning Motivation (%) | Category     | Increase (%) |
|---------------------|---------------------------------|--------------|--------------|
| Before Learning     | 56                              | Enough       |              |
| After Learning      | 88                              | Very Good    | 33           |

Based on Table 2 in general there is an increase in student learning motivation before and after learning. The results of student learning motivation before learning obtained an average of 56% with the category "Enough", while the results after learning increased by 88% with the category "Very Good".

The results of the learning motivation analysis obtained by \( t_{count} \) of 12.808, while the table with a confidence level of 0.05, the degree of freedom (df) 54-1 = 53 is 1.671. This shows that \( t_{count} > t_{table} \) so that the hypothesis that reads the use of pocket book can increase students' learning motivation "accepted". This happens because pocket books can make students motivated to learn. Based on the results of observations, it was shown that students were very enthusiastic in conducting discussion activities and actively asked the teacher if anyone did not understand. In addition, students were also very enthusiastic to present the results of the discussion, as reported by [28] that learning media can create an interesting and enjoyable learning atmosphere so that it can motivate students to learn.

Pocket books can increase student learning motivation also because through pocket book, students are more motivated to learn more about the material. In addition to pocket books, other media can also increase learning motivation, as reported by [29] that comics increase students' motivation with an average gain of 0.48 and 0.54 respectively. [30] also revealed that learning media can increase student learning motivation.

Learning motivation is a very important element to achieve a learning goal. Learning motivation can also encourage students to be more active in learning, so the teacher only acts as a facilitator, as reported by [31] that motivation is very necessary in the learning process. Students can develop activities and earn without carrying out the learning process if there is motivation.

### 3.4. Data on Student’s Responses

Students' responses greatly influence whether or not pocket book is used in the learning process. The response data shows that pocket books get responses from students by 80%. Based on Table 4, student responses to pocket books are included in the "good" category, so pocket books are appropriate for use in learning. This is as reported by [32] that product implementation shows that the average score reaches
4.43 and student responses reach 88.75 with very valid categories. [33] also revealed that the developed media received responses from students by 90%. The study of [34] also shows that the average acquisition of student responses to the developed media is 4.40. The study of [35] also shows that the pocket book developed received positive responses from students.

4. Conclusion
Based on the results of the research and discussion, some conclusions can be drawn, namely (1) the results of validation from expert validators and chemistry teachers that the quality of pocket books is included in the very good category, (2) the use of pocket books can improve student learning outcomes, (3) use pocket book can increase student learning motivation, (4) pocket book gets a good response from students.

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