Ta`dib: Jurnal Pendidikan Islam, 30(1), 2025
Avaliable Online At: http://jurnal.radenfatah.ac.id/index.php/tadib

Learning Media Innovation: Pocket Book Based on Mnemonics and PBL for Madrasah Students

Annisa Latifah Kotada[1*], Agus Subagyo[2], Ervan Johan Wicaksana[3]

[1,2,3] Universitas Jambi, Indonesia
[*]Corresponding Author Email: annisakotada23@gmail.com

ARTICLE INFO

Article History:
Recieved: 02-02-2025
Revised: 24-05-2025
Accepted: 30-06-2025

Keywords:
Pocket book;
Mnemonics Method;
Problem Based Learning.

ABSTRACT

This study aims to develop a learning tool—a mnemonic-based pocket book with Problem-Based Learning (PBL) evaluation—to help students better understand and retain complex biology concepts, especially those related to human transport and exchange systems. Employing a Research and Development (R&D) method with the 4D development model, the study was conducted at MAN 1 Musi Banyuasin with a small group of 6 students and a larger group of 28 students in grade XI. Both qualitative and quantitative data were collected. Qualitative data came from expert and teacher validation surveys, while quantitative data were derived from validator and user scores. The results showed high feasibility and acceptance. Subject matter experts rated the pocket book at 86.66% (very suitable), media experts at 95% (very suitable), and Biology teachers at 94.99% (very good). Student responses were also positive, with small group trials scoring 86.38% and large group trials scoring 86.84%, both in the "very good" category. The study concludes that this pocket book is an effective educational medium, particularly in low-tech environments. It enhances student comprehension and recall, aligns with the goals of the Merdeka Curriculum, and supports the development of critical thinking and problem-solving skills through PBL integration.

How to Cite:

Kotada, A. L., Subagyo, A., & Wicaksana, E. J. (2025). Learning Media Innovation: Pocket Book Based on Mnemonics and PBL for Madrasah Students. *Ta`dib: Jurnal Pendidikan Islam, 30*(1), 68-83

https://doi.org/10.19109/td.v30i1.26486

INTRODUCTION

Education serves as a critical vehicle for human development, yet ensuring that learning remains both effective and engaging—particularly in science subjects—remains challenging (Dayal & Tiko, 2020; Dhawan, 2020; Ferri et al., 2020; Kasneci et al., 2023; Simamora, 2020). At MAN 1 Musi Banyuasin, biology classes still rely on conventional tools—chiefly printed textbooks, slide decks, and occasional videos—while students are prohibited from using personal digital devices on campus. This mismatch between 21st-century learning demands and the media available in class has tangible consequences:

recent observations show that 71.4 % of students struggle to recall the sequence and function of enzymes in the "Transport and Exchange of Substances in Humans" unit.

Ideally, biology learning resources should integrate cognitive, creative, and problem-solving elements to foster deep conceptual understanding (Schmidt et al., 2009). In reality, students at MAN 1 Musi Banyuasin encounter complex physiological content through static, teacher-centered media, resulting in low retention and limited higher-order thinking. This clear disparity between current practice and the instructional ideals constitutes the central research gap.

To bridge this gap, we propose a mnemonic-enriched, problem-based learning (PBL) pocket book. Mnemonics systematically convert abstract information into vivid, memorable cues (Akpan et al., 2021; Siagian et al., 2023). PBL, meanwhile, situates knowledge in real-world problem contexts to stimulate critical thinking and collaboration (Widiastuti et al., 2023). A pocket-sized format (14 × 10 cm) is deliberately chosen for three reasons: 1) Portability: students can consult it during class, breaks, or study hall without violating the school's no-phone policy; 2) Ease of access: printed pages eliminate reliance on limited digital infrastructure, ensuring equitable use; and 3) Support for self-study: concise text, mnemonic visuals, and PBL prompts encourage iterative review outside formal lessons.

Previous studies confirm the independent benefits of mnemonics (Atimi et al., 2023; Cheng & So, 2020; Haryadi & Sunarsi, 2024; Hill, 2022; Mocko et al., 2024) and PBL-oriented media (Abdulah et al., 2021). However, none have explicitly combined these two approaches in a portable print medium targeting the "Transport and Exchange of Substances" topic, where multiple organ systems and enzyme pathways intersect. Addressing this overlooked intersection is expected to yield a practical, scalable model for improving biology learning outcomes under resource-limited conditions.

Accordingly, this study aims develops and validates a mnemonic-based, PBL pocket book tailored to class XI biology at MAN 1 Musi Banyuasin. Designed with Canva Premium, the book integrates concise explanations, vivid mnemonic anchors, QR-linked videos, and PBL worksheets—collectively aimed at enhancing students' conceptual mastery and long-term memory of human transport and exchange processes. With this approach, students are expected to understand and remember complex biology concepts better.

LITERATURE REVIEW

Mnemonic Method

The mnemonic method is a learning technique designed to help students remember information more effectively through the use of association, visualization, or repetition (Anjomafrouz & Tajalli, 2012). In the past three years, various studies have explored the application of mnemonic methods in educational contexts. One study by Yogantari et al. (2023) examined the use of mnemonics and Orton-Gillingham methods to improve early reading skills in children with mild intellectual disabilities. The results showed a significant improvement in reading ability after the intervention, with the mean score increasing from 29.14 in the initial baseline condition to 91.19 in the final baseline condition.

In addition, research by Basuni et al. (2023) at SMP IT Ar-Rahman Majalengka compared the ability to memorize physics formulas between students taught using the mnemonic method and the practice method. The results showed significant differences, where the mnemonic method was more effective in improving the ability to memorize physics formulas on substance pressure material. The mnemonic method can improve student memory by linking new information with existing knowledge, thus facilitating the learning process (Atimi et al., 2023; Junainah, 2023; Siagian et al., 2023). Bakken (2017) revealed that mnemonic strategies assist students with intellectual and developmental disabilities in remembering important information.

In this article, the Mnemonic method is also accompanied by a Problem Based Learning (PBL) Based Evaluation on the Material of Transport and Exchange of Substances in Humans. The application of the mnemonic method in Problem Based Learning (PBL) based evaluation on the material of transport and exchange of substances in humans can improve student understanding and retention (Atimi et al., 2023; Rusdiyanto & Mahmudh, 2019; Sumarno, 2023). In the context of PBL, students are faced with real problems that require solving, so the use of mnemonics can help them remember important concepts relevant to the problem (Mariyati et al., 2024; Wirkala & Kuhn, 2011).

For example, in learning the process of oxygen and carbon dioxide transport in the human body, students can use acronyms or visualizations to remember the stages and components involved. This is in line with previous research findings showing that mnemonic techniques can improve students' memory and learning outcomes in a variety of subjects, including science and math (DeLashmutt Kathy & Hastings, 2007; Jane Marcos et al., 2024; Siagian et al., 2023). Thus, the integration of the mnemonic method in PBL-based evaluation on the material of transport and exchange of substances in humans has the potential to increase learning effectiveness, help students remember important information, and apply it in the context of problem solving.

Building on the cognitive potency of mnemonics and the constructivist power of PBL, our work develops a pocket-book learning medium that fuses (1) compact, student-generated mnemonic visuals and (2) step-wise PBL tasks aligned with the Indonesian Merdeka curriculum. By empirically testing this hybrid in the “Transport and Exchange of Substances” unit, the study addresses an under-explored intersection in the global literature and offers a portable, low-tech model for resource-limited schools.

Problem Based Learning (PBL)

Problem-Based Learning (PBL) is a student-centered approach that emphasizes solving real-world problems to enhance critical thinking and deepen conceptual understanding (Arifianto & Koeswanti, 2022; Hmelo-Silver, 2004; Sumarno, 2023; Widiastuti et al., 2023). It has been widely applied across disciplines and proven effective in developing students’ analytical skills. In this study, PBL is integrated with mnemonic strategies to improve students’ memory and comprehension, particularly in learning complex biological topics such as the transport and exchange of substances in humans (Almulla, 2020; Arviani et al., 2023; Hidayati & Wagiran, 2020).

The use of mnemonic methods—such as acronyms, visualizations, and chunking—within the PBL framework provides a dual benefit: it aids memory retention while encouraging active learning (Azmi et al., 2024; Erdem, 2017). In this context, a pocket book was developed as a learning tool combining both strategies. The pocket book serves as a quick reference, supporting independent learning and encouraging collaboration and dialogue among students, which is central to the PBL process (Almulla, 2020; Rachmawati et al., 2024).

Studies show that combining PBL with visual and mnemonic aids can increase student engagement, motivation, and learning outcomes (Dole et al., 2017; Nisa & Arumdati, 2024; Raiyn, 2016). PBL presents students with complex, open-ended problems that reflect real-life situations (Cioca & Nerişanu, 2020; Karuniasari & Purwandari, 2022; Mohammed et al., 2016; Nieuwenstein et al., 2019). Working in groups, students identify what they know and need to learn, seek relevant information, and collaborate to propose solutions (Atimi et al., 2023; Indarti, 2016; Putnam, 2015). This fosters independence, critical thinking, and communication skills, which are essential for lifelong learning (Mayasari & Ramdiah, 2023; Savin-Baden, 2007; Sukackė et al., 2022).

The teacher plays a vital role as a facilitator, guiding students without giving direct answers and encouraging reflection throughout the process (Firmansyah et al., 2024). In science education, particularly topics like respiration or circulation, PBL allows students to explore and understand abstract concepts through real-life case studies (Díez-Palomar et al., 2021; Mystkowska-Wiertelak et al., 2021). This method not only improves understanding but also prepares students with 21st-century skills such as collaboration, creativity, and problem-solving, making it a highly relevant and effective approach in today's educational context (Nurwidodo et al., 2024; Saputra et al., 2019).

METHOD

This research employs the Research and Development (R&D) method as its primary approach, which is designed to produce and validate educational products through systematic procedures. The R&D model used in this study follows the 4D model developed, which consists of four main stages: define, design, develop, and disseminate with small and large group trials. Small group trials involved 6-12 people, while large groups involved 15-50 people. In this study, the product was validated through a small group trial with 2 biology teachers and 6 students of class XI MAN 1 Musi Banyuasin, as well as a large group trial with 28 students from the same class. The test instrument in the form of a questionnaire was used to assess the attractiveness of the developed media.

This study used random sampling technique with product trials conducted in class. Researchers explained the use of pocket books based on the mnemonic method and Problem Based Learning (PBL) evaluation to students, then gave a questionnaire to find out their responses. The research instruments included structured interviews with the biology teacher, Mrs. Indah Subaidah as well as questionnaires given to media experts, material experts, linguists, and students. The interview aims to understand the learning process and the need for developing teaching materials, supported by a written question guide to facilitate data

collection. The interview instrument was developed based on 13 key indicators reflecting the condition of biology learning, use of media, and the need for innovative learning tools. Technically, the interview questions consisted of 20 items, categorized into the following indicators, namely: curriculum used; use of learning media; difficulties in learning biology; school facilities supporting biology learning; student achievement in biology; students' interest in biology learning; student-teacher relationship in biology class; student learning outcomes; biology learning methods; need for the development of pocket book media; solutions to overcome learning difficulties; and difficult biology materials.

In this study using a data collection instrument in the form of a questionnaire regarding the feasibility of pocket book teaching materials using the mnemonic method equipped with this Problem Based Learning (PBL) based evaluation. The questionnaires used in this study are student needs analysis questionnaire, student characteristics questionnaire, media validation questionnaire, material validation questionnaire, language validation questionnaire, teacher assessment questionnaire and student response questionnaire. The instrument was developed to assess students' needs regarding biology learning media. It consisted of 5 aspects and 5 core indicators, elaborated through 20 questions as shown below: 1) Students' attitude toward biology subject: demonstrates interest and recognition of the subject's usefulness; 2) Students' attitude toward learning media: demonstrates awareness and perception of media usage in learning; 3) Students' attitude toward the mnemonic method: demonstrates familiarity and interest in using mnemonic techniques; 4) Students' attitude toward Problem-Based Learning (PBL): demonstrates knowledge and interest in the PBL approach; and 5) Students' attitude toward the topic of "Transport and Exchange of Substances in Humans": demonstrates interest and understanding of the content.

The title writing on the pocket book media display uses the mnemonic method which is equipped with a Problem Based Learning (PBL) based evaluation. Furthermore, at this stage an open questionnaire is given to a team of media experts and material experts containing questions related to the feasibility of pocketbook teaching materials. If it does not meet the feasibility, suggestions or criticism will be given from each team of experts. Furthermore, suggestions or criticism in the form of qualitative data that will be used for teaching materials.

Teaching materials that have been validated by a team of media experts and material experts to find out the shortcomings. With suggestions and input from the expert team, improvements or revisions are made for feasibility. After the assessment of the expert team, revisions were also made after obtaining the results of the trial of this teaching material to students. Open questionnaires were also used at the trial stage in the form of teacher response responses and student response responses to teaching materials that had been developed by researchers.

This research uses data analysis based on scores from questionnaires from validators, teachers, and students. Scoring converts instrument answers into quantitative values that reflect the research variables. The maximum score is obtained by multiplying the number of items by the highest score, while the minimum score by the lowest score. A needs

questionnaire and a learner characteristics questionnaire were used to collect data. This questionnaire was filled in by students in class XI MAN Musi Banyuasin. Data analysis for the needs questionnaire and student characteristics questionnaire was carried out using a *rating scale* with the following formula as outlined by Sudjana.

RESULTS

This research resulted in the development of a learning media product in the form of a pocket book that integrates the mnemonic method with Problem-Based Learning (PBL)–based evaluation, specifically designed for the biology topic "Transport and Exchange of Substances in Humans" for class XI students at MAN 1 Musi Banyuasin. The development process followed the four systematic stages of the 4D model: define, design, develop, and disseminate.

Define Stage

In the define stage, a thorough needs analysis was conducted to explore the challenges students face in learning the targeted topic. Data were collected through student questionnaires, teacher interviews, and classroom observations. The findings revealed that most students rely primarily on teacher explanations and printed textbooks as their main learning resources. The use of technology-based media was very limited due to school policies that restrict students from using personal gadgets in the learning environment.

Moreover, the material on human transport and exchange of substances was considered one of the most difficult topics by students. In particular, 71.4% of students experienced significant difficulty understanding enzyme sequences and physiological processes within the circulatory and respiratory systems. Interviews with biology teachers revealed that while the mnemonic strategy had previously been implemented in other topics, such as the motion system, it had not yet been applied to this topic. This situation underscored the urgency of developing an alternative, engaging, and practical learning resource that could help students improve retention and understanding of complex concepts.

Design Stages

During the design stage, the development of the pocket book began with a focus on structure, visual design, and pedagogical alignment with the Merdeka curriculum. The pocket book was conceptualized as a compact resource measuring 14 by 10 centimeters to ensure portability and ease of use. It was designed using Canva Premium and included key learning features such as concept maps, mnemonic visuals, real-world problem cases, and PBL-based evaluation questions.

QR codes were embedded to provide access to supplementary video content, enabling students to engage in self-directed exploration. The initial prototype, consisting of 32 pages, was printed with high-quality materials using 210 gsm ICT paper for the cover and 100 gsm HVS paper for the content pages. Layout decisions were made to ensure visual

clarity and prevent cognitive overload, particularly through the use of bold fonts, structured infographics, and concise text.

Develop Stage

Following the completion of the design, the product entered the develop stage. This phase involved expert validation and field testing. Validation was conducted by a team comprising a material expert and a media expert. In the first round of assessment, the material expert gave a score of 58.33%, indicating that the content was not yet feasible, while the media expert scored the product at 50%, also within the "not feasible" category. Revisions were made in response to their feedback, which included suggestions for improving the clarity of illustrations, enhancing the alignment between content and indicators, and refining the overall presentation. After the revisions, the second round of validation showed significant improvement: the material expert rated the pocket book at 86.66%, and the media expert at 95%, both falling within the "very feasible" category.

Field testing was then conducted with both small and large groups of students. The small group trial involved six students and resulted in a positive response, with an average score of 86.38%, indicating that the product was well received. The large group trial, which involved 28 students, yielded a similarly positive result, with an average response score of 86.84%. Additionally, responses from two biology teachers who reviewed the product showed an exceptionally high approval rating of 94.99%. These findings indicated that the product was effective, engaging, and suitable for use in the classroom.

Disseminate Stage

The final stage of the development process was dissemination. After undergoing revision and validation, the pocket book was distributed to all students in class XI B Health at MAN 1 Musi Banyuasin and was also submitted to the school library. Through this step, the media became accessible not only to current users but also to future students and teachers as an instructional resource. The integration of mnemonic strategies and PBL-based tasks within the compact, printed format made the product particularly useful in contexts where digital tools are limited.

Overall, the development process successfully produced a contextualized and validated learning tool that meets student needs and supports biology instruction. The pocket book effectively addresses students' difficulties in understanding the topic of transport and exchange of substances in humans by combining memory-enhancing strategies and real-world problem-solving in a format that is both accessible and engaging.

DISCUSSION

The development of pocket book media using the mnemonic method equipped with Problem Based Learning (PBL) based evaluation on the material of transport and exchange of substances in humans was developed through the 4D model which includes four stages, namely define, design, develop, and disseminate. In the first stage, Define, several analyses

were carried out such as beginning-end analysis, analysis of student characteristics, concept analysis, and formulation of learning objectives. The purpose of this stage is to identify the problems and needs of students who will use the product.

Based on observations at MAN 1 Musi Banyuasin, it is known that students get knowledge from teacher explanations and the main learning resources used are textbooks. In addition to textbooks, the media used in the biology learning process is still less varied, namely in the form of power point media and videos shown through projectors that are used alternately with other teachers. This is also because at MAN 1 Musi Banyuasin students are not allowed to use cellphones while in the school environment because it is feared that it will interfere with the learning process. For this reason, conventional learning media was chosen in the form of pocket books because it is easy to carry anywhere.

In addition, based on observations made to students of class XI B Health MAN 1 Musi Banyuasin (n = 35), it shows that students find it difficult to remember the sequence of systems and the use of enzymes in transport and substance exchange material with a percentage of difficult to understand (40%) and very difficult to understand (31.4%), consider easy (14.3%) and very easy (14.3%). Seeing the results of these observations, the teacher needs to make efforts to overcome these problems. There are many ways that teachers can do, for example, the use of appropriate media and learning strategies to deepen students' understanding of terms, especially in the material of Transport and Substance Exchange in Humans. According to Cognitive Load Theory, excessive intrinsic load in science topics can be offset by providing students with elaborative coding aids such as mnemonics, which reduce working-memory demands and free cognitive capacity for problem-solving (Anmarkrud et al., 2019; Sweller, 2020).

Transport and Exchange of Substances in Humans is one of the chapters in the independent curriculum of class XI SMA/MA which involves the digestive system, respiratory system, excretory system and is connected to the circulatory system in humans. The right learning media is needed to help students remember the sequence of enzyme systems and functions so that it does not feel burdensome for students. The utilization of mnemonic strategies in this pocket book aims to help students overcome the problems that arise due to the difficulty of remembering the sequence of enzyme systems and functions in the material of transport substances and substance exchange in humans.

According to Fasih et al. (2018) the Mnemonic learning method can improve students' memory more effectively than the conventional method.... This method can help strengthen students' memory because it teaches them how to memorize using two main principles: imagination and association. The involvement of these two principles makes it easier for students to optimize their memory. This technique allows students to remember the subject matter in a fun way, so they can more easily remember what is taught by the teacher.

Based on an interview with the XI grade biology teacher at MAN 1 Musi Banyuasin, he has used the mnemonic method on the material of the motion system using songs. However, in the material of transport and exchange of substances in humans has not been applied for that media development is needed. According to him, this method is very

effective because students feel helped in remembering the material. Research by Atimi et al. (2023) states that the application of the mnemonic method in improving student learning outcomes as a whole has run well and efficiently. Therefore, the use of mnemonics can be very beneficial for students in understanding and remembering crucial concepts in biology lessons.

The next stage is the design stage of the developed media, the researcher designs the product to be developed by making a prototype of pocket book media using the mnemonic method which is equipped with Problem Based Learning (PBL) based evaluation on the material of substances and transport in humans. Furthermore, researchers conducted validity tests involving material validators and media validators. Several revisions were made based on input from the validators until the product was deemed suitable for testing on students, which is part of the development stage.

The next stage is the development stage (develop). At this stage, researchers realize the design that has been designed previously and apply the storyboard that has been made with the help of Canva. This process includes color selection, determining the size and type of font, and compiling the material. After the process, the media was printed using 210 GSM ICT paper on the cover and 100 GSM HVS paper on the contents which were printed back and forth.

At this stage of development, before the trial was conducted, researchers also carried out validation by validators, both in terms of material and media, to ensure that the learning media developed was suitable for use. Input and suggestions from validators were used as a guide to improve the product so that it was ready to be tested. Validation was carried out twice for materials and media, until the product was declared feasible to be tested in the field without the need for revision. As stated by Handayani & Rahayu (2020) the validation results obtained from the validators are used to determine the feasibility of the products that researchers develop. In this study, there were two aspects that were validated, namely material aspects and media aspects.

Validation is carried out with the aim of ensuring that the product developed has been evaluated by validators who are experts in their fields, so that the level of validity of the product can be known. This process is also used to measure the feasibility of the product before testing. The validation process is carried out repeatedly based on suggestions from validators until the results are declared valid, so that the product is considered feasible to continue to the next stage.

The results of the first stage of material validation showed an overall average of 58.33% with a category, so it could not be tested. Therefore, improvements were needed based on the comments and suggestions given by the material experts. After the revision, the second stage of validation was carried out. At this stage, the validation results showed an increase with an average of 86.66% and fell into the very good category, so it was declared feasible to be tested in the field. Based on Figure 4.19. there is an increase in benefits. According to Putnam (2015) the use of the mnemonic method is beneficial because it helps remember, which of course also facilitates the learning process. Obstacles in learning will be reduced, so that it can increase students' motivation to study harder, which in turn allows

them to achieve optimal learning outcomes. Furthermore, media validation was carried out by media experts.

The results of the first stage of media validation showed an overall average of 50% with categories less good, so not yet able to be tested. Therefore, improvements are needed based on the comments and suggestions given by the material experts. After the revision, the second stage of validation was conducted. At this stage, the validation results showed an increase with an average of 95% and fell into the excellent category, so it was declared feasible to be tested in the field.

The high percentage of product quality is in accordance with indicators that continue to be refined, such as increasing the clarity of images, adjusting colors, text, and backgrounds so as not to disturb the concentration of students. The pocket book development in this study was carefully designed to be able to attract students to read it and study it. According to Shabiralyani et al. (2015) visual presentation is an important element that needs to be considered, because the appearance of the book is the first thing students see before starting to read.

The development of pocket book media using the mnemonic method equipped with Problem Based Learning (PBL) based evaluation on the material of transport and exchange of substances in humans that have been validated by a team of validators will be tested in the field to assess the responses of teachers and students to the development of this media. The trial of pocket book learning media using the mnemonic method equipped with Problem Based Learning (PBL) based evaluation on the material of transport and exchange of substances in humans was carried out at MAN 1 Musi Banyuasin, involving two biology subject teachers, six students for small groups, and 28 students for large groups.

In this trial, the media development of pocket book media using the mnemonic method equipped with Problem Based Learning (PBL) based evaluation on the material of transport and exchange of substances in humans will be shown to teachers and students. After that, teachers and students will fill out a questionnaire through an assessment sheet. The results of the trial showed that the assessment given by the Biology teacher of the product reached a percentage of 94.99%. For small group test subjects consisting of 6 students, the percentage was 86.38%, while for large groups involving 28 students, the percentage reached 86.84%. These figures indicate a positive response from teachers and students, with the average response of teachers and students classified in the very good category. The pocket book equipped with supporting components can help students develop their skills, including improving learning outcomes. The existence of this pocket book is also effective as a companion book in the student learning process. According to Nirnawati (2023) pocketbooks are proven to be effectively used as companion books to increase student interest in learning.

Increased interest in learning will certainly have a positive impact on student learning outcomes. This is in line with the research of Qurrota'aini et al. (2013) which shows that pocket books are effective as additional materials to increase student interest in learning. The increase in interest in learning certainly has an impact on student learning outcomes.

Therefore, pocket books are not used as the main learning resource, but as a learning companion.

The last stage is *dissemination*, which is carried out through the distribution of products in the XIB Health class totaling 34 students and further dissemination in the form of handing over pocketbooks using the mnemonic method equipped with Problem Based Learning (PBL) based evaluation on the material of transport and exchange of substances in humans to the school library at MAN 1 Musi Banyuasin. Researcher concluded that the pocket book using the mnemonic method equipped with Problem Based Learning (PBL) based evaluation on the material of transport and exchange of substances in humans developed is considered feasible to use as a learning medium to help students understand the material of transport and exchange of substances in humans. Based on data analysis that includes media validation, material validation, and the results of trials from teachers, small groups, and large groups, pocket book media using the mnemonic method equipped with Problem Based Learning (PBL) based evaluation on the material of transport and exchange of substances in humans that show satisfactory results.

CONCLUSION

The present study produced a mnemonic-based pocket-book medium that integrates Problem-Based Learning (PBL) evaluation to support class XI students in mastering the topic of transport and exchange of substances in humans. The finished product comprises thirty-two pages—cover, front matter, learning outcomes, concept maps, concise materials, PBL task cards, and supporting references—printed on 210 gsm ICT cover stock and 100 gsm HVS content paper in a handy 14 × 10 cm format. Expert appraisal established its quality: final media-expert validation rose to 86.66 %, while material-expert validation reached 95 %, both falling in the “very feasible” range. Equally positive were the classroom stakeholders: teacher evaluations averaged 94.99 % (“very good”), and student responses registered 86.38 % in the small group and 86.84 % in the large group (“very good”). These results confirm that the developed pocket book effectively addresses the research objective, namely the need for an innovative learning medium that improves students’ comprehension of complex human-physiology concepts while being highly acceptable to teachers and learners.

Beyond meeting its immediate aim, the study makes two practical contributions. First, it demonstrates how mnemonic cues can be seamlessly embedded within PBL tasks to foster both factual recall and higher-order thinking in a low-tech, portable format; second, it offers a concrete prototype that other schools or curriculum developers may adapt when designing mnemonic-enhanced, PBL-integrated resources for similarly challenging biology topics. Future investigations could extend this work by trialling the pocket book across diverse educational settings—different regions, school types or grade levels—to test its generalisability, and by creating digital or interactive versions that may further boost engagement and accessibility in contexts where technology use is permitted.

REFERENCES

Abdulah, A., Mustadi, A., & Fitriani, W. (2021). PBL-Based Interactive Multimedia in Improving Critical Thinking Skills. *JPI (Jurnal Pendidikan Indonesia)*, *10*(1), 136. https://doi.org/10.23887/jpi-undiksha.v10i1.25521

Akpan, J., Notar, C. E., & Beard, L. (2021). The Impact of Mnemonics as Instructional Tool. *Journal of Education and Human Development* , *10*(3), 2334–2978. https://doi.org/10.15640/jehd.v10n3a3

Almulla, M. A. (2020). The Effectiveness of the Project-Based Learning (PBL) Approach as a Way to Engage Students in Learning. *SAGE Open*, *10*(3). https://doi.org/10.1177/2158244020938702

Amaliah Basuni, E. N., Bastian, N., & Fatnah, N. (2023). Penerapan Metode Mnemonik terhadap Kemampuan Menghafal Rumus-rumus Fisika pada Materi Tekanan Zat Kelas VIII SMP IT Ar-Rahman. *Jurnal Pendidikan*, *11*(1), 178–184. https://doi.org/10.36232/pendidikan.v11i1.3040

Amerstorfer, C. M., & Freiin von Münster-Kistner, C. (2021). Student Perceptions of Academic Engagement and Student-Teacher Relationships in Problem-Based Learning. *Frontiers in Psychology*, *12*, 713057. https://doi.org/10.3389/fpsyg.2021.713057

Anjomafrouz, F., & Tajalli, G. (2012). Effects of Using Mnemonic Associations on Vocabulary Recall of Iranian EFL Learners over Time. *International Journal of English Linguistics*, *2*(4). https://doi.org/10.5539/ijel.v2n4p101

Anmarkrud, Ø., Andresen, A., & Bråten, I. (2019). Cognitive Load and Working Memory in Multimedia Learning: Conceptual and Measurement Issues. *Educational Psychologist*, *54*(2), 61–83. https://doi.org/10.1080/00461520.2018.1554484

Arifianto, A., & Koeswanti, H. D. (2022). The Difference between Problem Based Learning Model and Discovery Learning Model on Students' Critical Thinking Ability. *Journal for Lesson and Learning Studies*, *5*(2), 164–171. https://doi.org/10.23887/jlls.v5i2.49744

Arviani, F. P., Wahyudin, D., & Dewi, L. (2023). The Effectiveness of Problem Based Learning Model in Improving Students' Higher Order Thinking Skills. *JPI (Jurnal Pendidikan Indonesia)*, *12*(4), 627–635. https://doi.org/10.23887/jpiundiksha.v12i4.65606

Atimi, N. D., Afandi, A., & Tenriawaru, A. B. (2023). The effect of mnemonics method on students' retention and learning outcomes in the learning of biology. *Biosfer*, *16*(2), 296–303. https://doi.org/10.21009/biosferjpb.28000

Azmi, U., Aminah, A., & Kholis, A. (2024). Developing bilingual expressions pocketbook for secondary students at Assalafiyah Language Center (ALC). *Journal of Research on English and Language Learning (J-REaLL)*, *5*(1), 84–99. https://doi.org/10.33474/j-reall.v5i1.21444

Bakken, J. P. (2017). Mnemonic Strategies: Helping Students with Intellectual and Developmental Disabilities Remember Important Information. *Global Journal of*

Intellectual & Developmental Disabilities, *2*(3). https://doi.org/10.19080/GJIDD.2017.02.555587

Cheng, Y. C., & So, W. W. M. (2020). Managing STEM learning: a typology and four models of integration. *International Journal of Educational Management*, *34*(6), 1063–1078. https://doi.org/10.1108/IJEM-01-2020-0035

Cioca, L.-I., & Nerișanu, R. A. (2020). Enhancing Creativity: Using Visual Mnemonic Devices in the Teaching Process in Order to Develop Creativity in Students. *Sustainability*, *12*(5), 1985. https://doi.org/10.3390/su12051985

Dayal, H. C., & Tiko, L. (2020). When are we going to have the real school? A case study of early childhood education and care teachers' experiences surrounding education during the COVID-19 pandemic. *Australasian Journal of Early Childhood*, *45*(4), 336–347. https://doi.org/10.1177/1836939120966085

Dhawan, S. (2020). Online Learning: A Panacea in the Time of Covid-19 Crisis. *Journal of Educational Technology Systems*, *49*(1), 5–22. https://doi.org/10.1177/0047239520934018

Díez-Palomar, J., Chan, M. C. E., Clarke, D., & Padrós, M. (2021). How does dialogical talk promote student learning during small group work? An exploratory study. *Learning, Culture and Social Interaction*, *30*, 100540. https://doi.org/10.1016/j.lcsi.2021.100540

Dole, S., Bloom, L., & Doss, K. K. (2017). Engaged Learning: Impact of PBL and PjBL with Elementary and Middle Grade Students. *Interdisciplinary Journal of Problem-Based Learning*, *11*(2). https://doi.org/10.7771/1541-5015.1685

Erdem, R. (2017). Students with Special Educational Needs and Assistive Technologies: A Literature Review. *TOJET: The Turkish Online Journal of Educational Technology*, *16*(1).

Fasih, P., Izadpanah, S., & Shahnavaz, A. (2018). The Effect of Mnemonic Vocabulary Instruction on Reading Comprehension of Students. *International Journal of Applied Linguistics and English Literature*, *7*(3), 49. https://doi.org/10.7575/aiac.ijalel.v.7n.3p.49

Ferri, F., Grifoni, P., & Guzzo, T. (2020). Online Learning and Emergency Remote Teaching: Opportunities and Challenges in Emergency Situations. *Societies*, *10*(4), 86. https://doi.org/10.3390/soc10040086

Firmansyah, Irja Putra Pratama, Mukti Ali, Miftahul Husni, & Siti Fatimah. (2024). The Concept Of Implementing Active Learning Strategies In Islamic Religious Education Learning. *IJGIE (International Journal of Graduate of Islamic Education)*, *5*(2), 125–135. https://doi.org/10.37567/ijgie.v5i2.3212

Ghulam S, Khuram S H, Naqvi H, & Nadeem I. (2015). Impact of Visual Aids in Enhancing the Learning Process Case Research: District Dera Ghazi Khan. *Journal of Education and Practice*, *6*(19), 226–233.

Handayani, D., & Rahayu, D. V. (2020). Pengembangan Media Pembelajaran Interaktif Berbasis Android Menggunakan Ispring Dan Apk Builder Untuk Pembelajaran Matematika Kelas X Materi Proyeksi Vektor. *M A T H L I N E Jurnal Matematika Dan Pendidikan Matematika*, *5*(1), 12–25. https://doi.org/10.31943/mathline.v5i1.126

Haryadi, R. N., & Sunarsi, D. (2024). Application of Mnemonic Method to Improve English Language Learning Outcomes. *Spectrum: Multidisciplinary Journal*, *1*(1), 40–48.

Hidayati, R. M., & Wagiran, W. (2020). Implementation of problem-based learning to improve problem-solving skills in vocational high school. *Jurnal Pendidikan Vokasi*, *10*(2). https://doi.org/10.21831/jpv.v10i2.31210

Hill, A. C. (2022). The Effectiveness of Mnemonic Devices for ESL Vocabulary Retention. *English Language Teaching*, *15*(4), 6. https://doi.org/10.5539/elt.v15n4p6

Hmelo-Silver, C. E. (2004). Problem-Based Learning: What and How Do Students Learn? *Educational Psychology Review*, *16*(3), 235–266. https://doi.org/10.1023/B:EDPR.0000034022.16470.f3

Indarti, I. (2016). Implementing Project-Based Learning (PBL) in Final Collection to Improve the Quality of Fashion Design Student. *Innovation of Vocational Technology Education*, *12*(1), 22–30. https://doi.org/10.17509/invotec.v12i1.4500

Jane Marcos, R. U., Joy Asuncion, C. A., Joy Agbayani, L. A., Dave Mabborang, F. N., & Dave, F. N. (2024). Original Research Article Marcos et al. *Asian Journal of Education and Social Studies*, *2024*(6), 242–249. https://doi.org/10.9734/ajess/2024/v50i61410ï

Junainah, S. (2023). Application of Mnemonic Learning Methods in Improving Students' Mufradat Remember At Mts Negeri 1 Probolinggo. *Society and Humanity*, *01*(01), 2023.

Karuniasari, Z., & Purwandari, E. (2022). The Effectiveness of the Mnemonic Method on the Ability to Read Hijaiyah Letters in Mentally Disabled Children. *Pedagogia*, *20*(2), 153–162. https://doi.org/10.17509/PDGIA.V20I2.47281

Kasneci, E., Sessler, K., Küchemann, S., Bannert, M., Dementieva, D., Fischer, F., Gasser, U., Groh, G., Günnemann, S., Hüllermeier, E., Krusche, S., Kutyniok, G., Michaeli, T., Nerdel, C., Pfeffer, J., Poquet, O., Sailer, M., Schmidt, A., Seidel, T., … Kasneci, G. (2023). ChatGPT for good? On opportunities and challenges of large language models for education. *Learning and Individual Differences*, *103*, 102274. https://doi.org/10.1016/j.lindif.2023.102274

Kathy, D., & Hastings, N. (2007). *A Study of the Role of Mnemonics in Learning Mathematics*.

Mahmoud, N. M., & Abdelsalam, H. E. (2016). Using Mnemonics Strategies to Improve Primary Stage Pupils' EFL Vocabulary Learning and Retention Skills. *Research Journal of English Language and Literature*, *4*(4), 705–718.

Mariyati, M., Wijaya, C., & Anas, N. (2024). The Effect of Problem Based Learing (PBL) Learning Model and Learning Independence on Problem Solving Ability of Ali Bin Abu Talib Integrated Islamic Junior High School Students Deli Serdang. *Tadrib: Jurnal Pendidikan Agama Islam*, *10*(1), 61–69.

Mayasari, R., & Ramdiah, S. (2023). The effect of problem-based learning (PBL) on different academic abilities on critical thinking of grade XI students on coordination system material. *BIO-INOVED : Jurnal Biologi-Inovasi Pendidikan*, *5*(1), 64. https://doi.org/10.20527/bino.v5i1.15442

Mirnawati, M., Sulfasyah, S., Rahmawati, R., & Rahmadhani, A. (2023). The Effectiveness

of an Android-Based Digital Pocket Book on the Indonesian Language Subject for Fifth-Grade Students. *International Journal of Social Science and Human Research*, *06*(03). https://doi.org/10.47191/ijsshr/v6-i3-01

Mocko, M., Wagler, A. E., Lesser, L. M., Francis, W. S., Blush, J. M., Schleicher, K., & Barrientos, P. S. (2024). What They Remember May Not Be What They Understand: A Study of Mnemonic Recall and Performance by Introductory Statistics Students. *Journal of Statistics and Data Science Education*, *32*(4), 416–431. https://doi.org/10.1080/26939169.2024.2334905

Nisa, S., & Arumdati, A. (2024). Systematic Literature Review (SLR): Analisis Upaya Guru dalam Mengatasi Kesulitan Belajar Peserta Didik di Sekolah Dasar. *TSAQOFAH*, *4*(4), 3118–3127. https://doi.org/10.58578/tsaqofah.v4i4.3202

Nurwidodo, N., Wahyuni, S., Hindun, I., & Fauziah, N. (2024). The effectiveness of problem-based learning in improving creative thinking skills, collaborative skills and environmental literacy of Muhammadiyah secondary school students. *Research and Development in Education (RaDEn)*, *4*(1), 49–66. https://doi.org/10.22219/raden.v4i1.32123

Putnam, A. L. (2015). Mnemonics in education: Current research and applications. *Translational Issues in Psychological Science*, *1*(2), 130–139. https://doi.org/10.1037/tps0000023

Qurrota'aini, S. S., & Sukirno, S. (2013). Pocketbook As Media Of Learning To Improve Students' Learning Motivation. *Jurnal Pendidikan Akuntansi Indonesia*, *11*(2). https://doi.org/10.21831/jpai.v11i2.1692

Rachmawati, U., Pradita, L. E., Ulyan, M., & Sotlikova, R. (2024). The Implementation of Project-Based Learning in Higher Education: A Case Study in the Indonesian Context. *Journal of Languages and Language Teaching*, *12*(1), 475. https://doi.org/10.33394/jollt.v12i1.8976

Radović, T., & Manzey, D. (2019). The Impact of a Mnemonic Acronym on Learning and Performing a Procedural Task and Its Resilience Toward Interruptions. *Frontiers in Psychology*, *10*, 2522. https://doi.org/10.3389/fpsyg.2019.02522

Raiyn, J. (2016). The Role of Visual Learning in Improving Students' High-Order Thinking Skills. *Journal of Education and Practic*, *7*(24).

Rusdiyanto, R., & Mahmudh, M. (2019). The Application of Problem Based Learning (PBL) Methods To Improve Student Learning Outcomes. *Jurnal Axioma : Jurnal Matematika Dan Pembelajaran*, *4*(2), 112–119. https://doi.org/10.36835/axi.v4i2.458

Saputra, M. D., Joyoatmojo, S., Wardani, D. K., & Sangka, K. B. (2019). Developing critical-thinking skills through the collaboration of Jigsaw model with problem-based learning model. *International Journal of Instruction*, *12*(1), 1077–1094. https://doi.org/10.29333/iji.2019.12169a

Savin-Baden, M. (2007). Challenging Models and Perspectives of Problem-Based Learning. In *Management of Change* (pp. 9–29). BRILL. https://doi.org/10.1163/9789087900922_003

Schmidt, D. A., Baran, E., Thompson, A. D., Mishra, P., Koehler, M. J., & Shin, T. S. (2009).

Technological Pedagogical Content Knowledge (TPACK): The Development and Validation of an Assessment Instrument for Preservice Teachers. *Journal of Research on Technology in Education*, *123*.

Siagian, D. T., Maida, N., Irianto, D. M., & Sukardi, R. R. (2023). The Effectiveness of Mnemonic Device Techniques in Improving Long-Term Memory in Learning in Elementary Schools: A Literature Review. *Equator Science Journal*, *1*(1), 24–30. https://doi.org/10.61142/esj.v1i1.4

Simamora, R. M. (2020). The Challenges of Online Learning during the COVID-19 Pandemic: An Essay Analysis of Performing Arts Education Students. *Studies in Learning and Teaching*, *1*(2), 86–103. https://doi.org/10.46627/silet.v1i2.38

Sukackė, V., Guerra, A. O. P. de C., Ellinger, D., Carlos, V., Petronienė, S., Gaižiūnienė, L., Blanch, S., Marbà-Tallada, A., & Brose, A. (2022). Towards Active Evidence-Based Learning in Engineering Education: A Systematic Literature Review of PBL, PjBL, and CBL. *Sustainability*, *14*(21), 13955. https://doi.org/10.3390/su142113955

Sumarno, S. (2023). Application of the PBL (Problem-Based Learning) Method with the STEAM (Science, Technology, Engineering, Arts, and Mathematics) Approach to Improve Students' Creative Ability in Indonesia. *PINISI Discretion Review*, *6*(2), 243. https://doi.org/10.26858/pdr.v6i2.44421

Sweller, J. (2020). Cognitive load theory and educational technology. *Educational Technology Research and Development*, *68*(1), 1–16. https://doi.org/10.1007/s11423-019-09701-3

Widiastuti, I. A. M. S., Mantra, I. B. N., Utami, I. L. P., Sukanadi, N. L., & Susrawan, I. N. A. (2023). Implementing Problem-based Learning to Develop Students' Critical and Creative Thinking Skills. *JPI (Jurnal Pendidikan Indonesia)*, *12*(4), 658–667. https://doi.org/10.23887/jpiundiksha.v12i4.63588

Wirkala, C., & Kuhn, D. (2011). Problem-Based Learning in K–12 Education. *American Educational Research Journal*, *48*(5), 1157–1186. https://doi.org/10.3102/0002831211419491

Yogantari, L. P. W., Yoenanto, N. H., & Marhaeni, A. (2023). Meningkatkan Kemampuan Membaca Permulaan Melalui Metode Mnemonik dan Orton-Gillingham pada Anak dengan Disabilitas Intelektual. *Jurnal Diversita*, *9*(2), 167–175. https://doi.org/10.31289/diversita.v9i2.8225