

## Development of Android-Based Learning Media for High School Students in Indonesia: A Systematic Review of Literature

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### ABSTRACT

This study aims to comprehensively examine research on developing android-based learning media (ABLM) in Indonesia from 2015 to 2022. The research method used is the SLR to explore 32 articles from the accreted journals Sinta 1 and Sinta 2 by the Kemristekdikti RI with the keyword "Android" from 2015 to 2022. The results show that the trend of ABLM development research in Indonesia in the last eight years has continued to increase. The ADDIE model has been the most widely used research and development (RnD) method over the previous eight years. The questionnaire is the most dominant data collection tool used in Indonesia. The most researched subject related to research on developing ABLM in Indonesia is chemistry. The Indonesian Science Education Journal is the journal that has contributed the most to publishing ABLM development articles. The theory used in ABLM development research is problem-solving, critical thinking, and self-diagnosis skills. The study indicates that ABLM influences problem-solving (PS) abilities, critical thinking, and self-diagnosis. Meanwhile, a brief outline of the ABLM procedure for development for further study was presented in this paper

**Keywords:** *Developing Learning Media, Android-Based Learning, Learning Media*

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### INTRODUCTION

Learning media is very important as an intermediary in conveying the contents of a message from material given by the teacher to students. In the past, in the field of learning in schools and tertiary institutions, teachers usually used media in front of the class to make conveying the aims and objectives of the subjects or material being taught easier. However, at this time, along with the times, the media is no longer limited to space (Rachma et al., 2020). Today's media must be used anywhere and anytime by students and teachers (Deda et al., 2023). Learning source that can be used anywhere should support students to learn independently (Kuswanto et al., 2021). The media, as an intermediary, must function to help achieve an educational goal. Learning media also plays a role in transferring messages, stimulating thoughts and making it simple for learners to study autonomously.

In terms of achieving learning independence, learning media is needed. However, teachers must be able to integrate information and communication technology following the times. With advances in technology such as Android, it might be a completely new medium for teachers to impart topic information to pupils. The use of ABLM is not restricted by location or timeframe (Kuswanto et al., 2021). A smartphone, often known as Android, is an operating system (OS) for smartphones and tablets that acts as an intermediate between gadgets (devices and their usage, allowing users to communicate with their gadgets and execute apps available on phones) (Abdullah et al., 2019; Hadi & Marpanaji, 2019). Android is a Linux-based OS, middleware, and applications specifically designed for mobile devices. Move like a smartphone or tablet [2], (Apsari & Rizki, 2018) with several advantages, such as user-friendly, open source, and support for various applications (Apsari & Rizki, 2018). However, the benefits of technological advances have not been seen in most learning in Indonesia (Kuswanto et al., 2021).

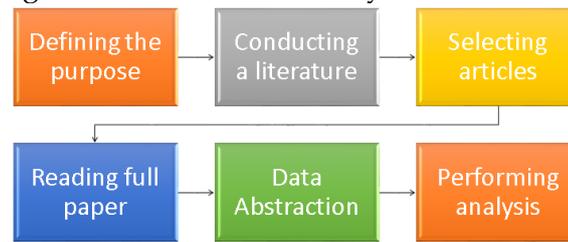
According to the circumstances described previously, an Android-based learning media (ABLM) is needed (Kuswanto et al., 2021). Educational media may be created by learners within and outside of the classroom, and instructors can utilize it to aid in learning. Furthermore, Android-based learning material may be designed to increase scientific literacy (Siahaan et al., 2021), enhance high-level thinking skills of high school students (HSS) (Dasilva et al., 2019), to improve PS skills (Fatma & Partana, 2019; Verawati et al., 2022). Another goal is to improve Learning Outcomes [10] and students' Critical Thinking Skills (CTS) (Sulistiani et al., 2022). The objectives of developing ABLM can be guaranteed to be successful because currently, students at school are millennial students who are very creative using Android smartphones. For this reason, ABLM is needed as a source of information (Saputra et al., 2018). However, no comprehensive study related to ABLM research uses SINTA metadata. Therefore it is important to unify multiple libraries from SINTA metadata. In addition, this research provides an overall portrait of ABLM research in Indonesia. This literature study will focus on the following research questions,

- i. What are the research trends in developing ABLM in Indonesia (2015-2022)?
- ii. How is the distribution of research on developing ABLM based on journal sources, materials, locations, subjects and methods used in Indonesia (2015-2022)?
- iii. What are the underlying theories and research outputs of ABLM in Indonesia?

## **METHOD**

The process of systematic review of literature (Hidayati & Prahmana, 2022; Prahani et al., 2022) followed the direction of researchers (SUPRAPTO, 2020; Suprpto et al., 2020). The review process begins with determining objectives and continues with a literature search. Then the process continues with selecting articles by reading titles, abstracts, and keywords to capture the main ideas from previous studies. Reading a full paper became necessary for clarification and depth of understanding (SUPRAPTO, 2020; Suprpto et al., 2020). The approach continues with data abstraction and analysis to summarize the study's results.

Figure 1. The Procedure of Systematic Review



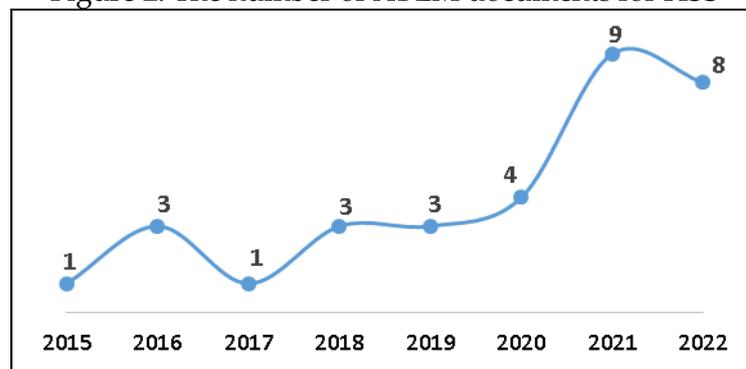
This investigation examined a literature review with the highest rating by the Kemristekdikti RI as excellence in peer-reviewed journals with outstanding management and publishing quality.. According to Figure 1, researchers search for articles on the Sinta database after setting goals. The search results obtained 100 papers from 47 accredited journals ranked 1st and 2nd nationally. The search criteria for articles in every Sinta 1 and Sinta 2 journal in Indonesia are the search keyword "Android". Then the researcher selects pieces by reading the titles, abstracts and keywords of the 100 articles.

Furthermore, 32 reports were obtained on the "Development of learning media" from 2015 to 2022 using Indonesian and English. Finally, the 32 articles were further analyzed by reading the full papers and abstracting the data with the help of the Microsoft Excel application. Finally, do an analysis based on the questions and objectives of this research.

## RESULT

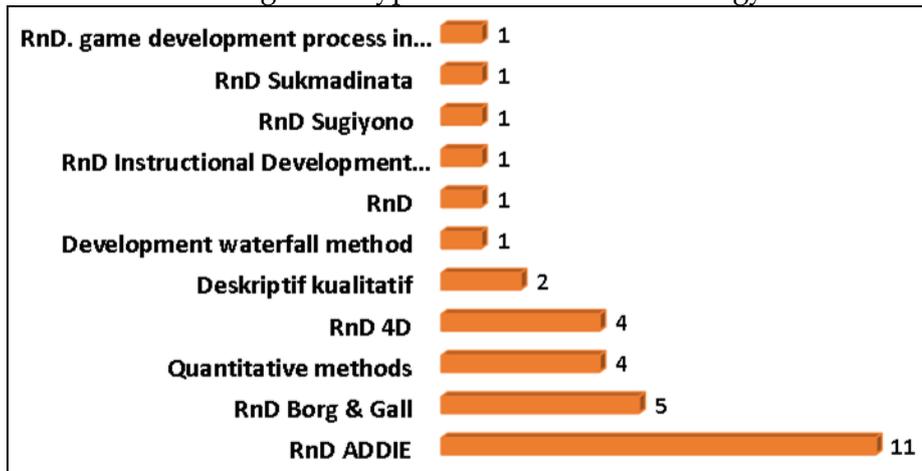
Based on 32 articles on developing ABLM in 8 years (2015-2022), the Android Based Learning Media (ABLM) research trend has tended to increase in the last eight years, as shown in Figure 2.

Figure 2. The number of ABLM documents for HSS



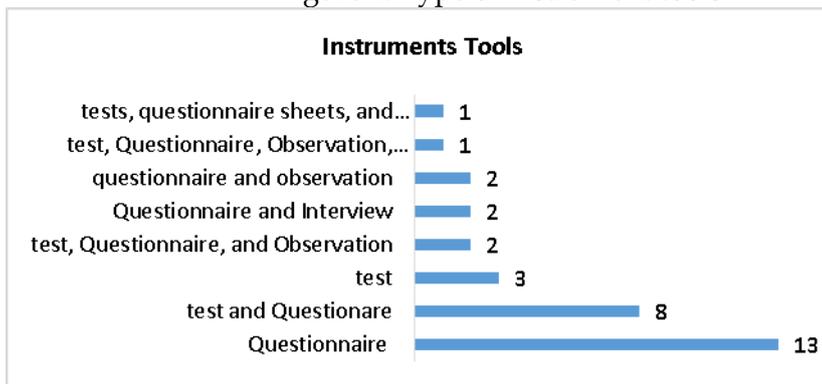
It is clear from Figure 2 that in 2015, there was only one script for developing ABLM. However, from 2017 to 2022, research related to ABLM tends to increase monotonically. The peak of the increase in 2015-2022 occurred in 2021, namely, 9 ABLM documents for HSS. In general, ABLM tends to increase.

Figure 3. Type of Research Methodology



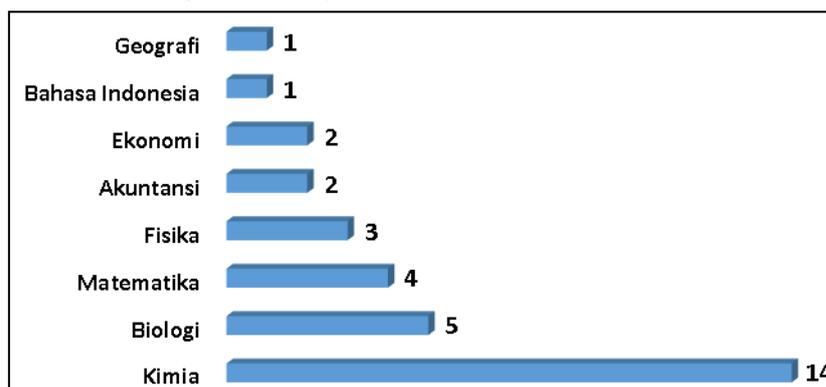
It may be shown in Figure 3 that 11 research documents use the ADDIE model ABLM development research method. At the same time, five papers used the Borg & Gall RnD model, four papers used the quantitative approach, four articles used the RND, and two documents used a qualitative descriptive method. Each document uses the waterfall method, RnD, RnD Instructional development, RnD Sugiyono, RnD Sukmadinata, and RnD game development.

Figure 4. Type of Instrument tools



Based on Figure 4, the most widely used instrument tools are questionnaires, namely 13 documents, followed by 8 document tests and questionnaires, three documents of the test, two documents using tests, Questionnaires, and interviews, two documents using Questionnaires and observations, 1 using tests, remarks, comments and interviews, and one document using the test, questionnaire sheets, and documentation.

Figure 5. Subjects matter of ABLM



Based on Figure 5, the dominant subject area is chemistry, namely 14 documents, followed by biology with five papers, 4 in mathematics subject, 3 in physics, two in accounting, two in economics, 1 in the Indonesian language, and 1 in the geography area. Graph 5 shows that in the period 2015-2022, the subjects of mathematics and natural sciences were more developed than the social sciences. Mathematics and Natural Sciences have dominated ABLM in the last eight years (2015-2022) at the high school level.

Figure 6. The Number of ABLM documents based on accredited journals in Indonesia



According to Figure 6, the four sinta one or sinta two journals that contributed the most were the Jurnal Pendidikan Sains Indonesia (5 documents), the Jurnal Pendidikan IPA Indonesia (4 papers), the Journal Of Education Technology (3 copies), Jurnal Inovasi Pendidikan IPA (3 paper). Other journals also contributed, as can be seen in Figure 6.

The discussion section presents a systematic review of 32 articles taken from first and second ranked journals at SINTA. The differences our main finding among previous systematic review are focus on theory used and reseach outcome. 32 articles analyzed in this study were grouped according to the subject matter and examined carefully, from Table 1 to Table 6.

Table 1. A summary of the selection of Accounting publications examined in this investigation.

No.	Author(s)	Theory used	Learning output	Research outcome
	Pratama Putra & Susilowibowo (Pratama Putra & Susilowibowo, 2021)	It does not elaborate	Android-based accounting computer e-module for the Accurate Accounting V5 application program, teaching material products developed are possible to employ during the teaching process.	It is not specified
	Saputri et al. (Saputri et al.,	It does not	The Android game-based learning material "Go Accounting" is the product	It is not specified

2020)	elaborate	of this research. According to material specialists, media experts, instructors, and students, producing educational resources is viable.
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Table 1 shows a sample of ABLM development research for accounting subjects in HSS in Indonesia. Research (Pratama Putra & Susilowibowo, 2021) is only limited to the feasibility test of the Accurate Accounting V5 application in the learning process. However, it has not yet reached the stage of implementation and testing the effectiveness of the media. In addition, (Pratama Putra & Susilowibowo, 2021) does not clearly explain the theory used in development research. Next, the researcher did not expressly state the research output (see Table 1).

Furthermore (Saputri et al., 2020), it is only limited to the feasibility test of the Go Accounting application in the learning process. However, it has not yet reached the stage of implementation and testing the effectiveness of the media. In addition, (Saputri et al., 2020) does not clearly explain the theory used in development research. Next, the researcher did not expressly state the research output. In the same way, Faisal & Leiliyanti (Faisal & Leiliyanti, 2020) wrote an article in Indonesian examined in this investigation. The production of Learning from Faisal & Leiliyanti's research (Faisal & Leiliyanti, 2020) is that learning media for writing poetry based on Android applications is declared suitable for learning. However, they did not elaborate on the theory or express their research output. The same thing also applies to articles on geography, Lasfika et al. (Lasfika et al., 2022) do not indicate the idea used or expressly state the research output.

Table 2. A summary of the selection of biology publications examined in this investigation.

No.	Author(s)	Theory used	Learning output	Research outcome
	Suryanda et al. (Suryanda et al., 2018)	It does not elaborate	The mobile learning multimedia module on biodiversity material has been successfully developed and gets value with reasonable interpretation.	Using mobile learning multimedia modules on biodiversity material improves student learning outcomes on biodiversity material.
	Sulistiani et al. (Sulistiani et al., 2022)	Critical thinking	An improvement in pupils' critical thinking abilities	Using an electronic module focused on socio-scientific concerns utilizing Android appy pie enhances students' CTS.
	Panjaitan et al. (Panjaitan et al., 2020)	It does not elaborate	These instructional game-based multi-media interactions are appropriate for use as an instructional tool in high school on respiratory system content.	It is not specified

No.	Author(s)	Theory used	Learning output	Research outcome
	Khairini & Yogica (Khairini & Yogica, 2021)	It does not elaborate	It is possible to employ learning media in the form of an Android packaging kit (Apk).  Mobile media learning got a very feasible category. The average assessment percentage from the expert validation team is 82.75%. After running the program, the N-gain value achieved is 66.5 based on the initial and subsequent tests numbers.	It is not specified  Mobile media instruction increases students' knowledge of subjects, and virtually every learner reacts significantly
	Susanto et al. (Susanto et al., 2022)	It does not elaborate		

Table 2 shows a sample of ABLM development research for biology subjects. Only one article presents the theory of higher-order thinking used in developing ABLM. Sulistiani et al. (Sulistiani et al., 2022) showed a rise in the CTS of learners. In addition, Sulistiani et al. (Sulistiani et al., 2022) state-specific research outputs, namely the use of electronic modules together with the socio-scientific issue-based android, affect improving students' CTS. Other researchers who stated specific research outputs were Suryanda et al. (Suryanda et al., 2018); multimedia mobile learning modules increased student learning outcomes on biodiversity material. In addition, Susanto et al. (Susanto et al., 2022) stated the research output specifically: mobile learning media boost learners conceptual knowledge, and virtually every learner reacted favourably. Apart from (Sulistiani et al., 2022), (Suryanda et al., 2018), and (Susanto et al., 2022), other researchers did not state their research output expressly. In general, 2 of the 5 ABLM development studies for biology subjects did not explicitly state the research output, and four did not say the theory used.

Table 3. A summary of the selection of economic publications was examined in this investigation.

No.	Author(s)	Theory used	Learning output	Research outcome
	Setiawardhani (Setiawardhani, 2021)	It does not elaborate	Android-based multimedia design for high school economics instruction fits legitimate, effective, and practical requirements.	It is not specified
	Rafsanjani et al. (Rafsanjani et al., 2021)	It does not elaborate	Interactive media based on Android for Economics high school is accurate, practicable, and successful in increasing pupil performance results.	It is not specified

Table 3 shows a sample ABLM development research for economics subjects. Two studies by Setiawardhani (Setiawardhani, 2021) and Rafsanjani et al. (Rafsanjani et al., 2021) did not state the theory used in their study. In addition, they also did not expressly state the output of their research. This part will be a gap in research economics subjects at the high school level in Indonesia.

Table 4. A summary of the selection of Physics publications examined in this investigation.

No.	Author(s)	Theory used	Learning output	Research outcome
	Taufiq et al. (Taufiq et al., 2016)	It does not elaborate	Mobile learning science apps of the eclipse phenomena in the conservation concept are being created and may be utilized to investigate the idea of the eclipse.	It is not specified
	Sari et al. (D. K. Sari et al., 2018)	self-diagnosis skill	The Isomorphic Physics app used in physics learning significantly impacted the development of HSS's analogical transfer and self-diagnostic skills.	It is not specified
	Iqbal et al. (Iqbal et al., 2016)	It does not elaborate	The help and documentation category has minor problems, requiring a few fixes and additions.	It is not specified

Table 4 shows a sample of the ABLM development research for the Physics subject. Of the three studies on physics subjects, only Sari et al. (D. K. Sari et al., 2018) stated the theory used, namely the theory of self-diagnosis skills. However, Sari et al. (D. K. Sari et al., 2018) did not expressly state the research output. Two other researchers, Taufiq et al. (Taufiq et al., 2016) and Iqbal et al. (Iqbal et al., 2016), did not say the theory used and did not expressly state the research output they produced. As a result, there is an opportunity for a research gap in high school physics subjects, namely the development of ABLM in physics subjects for HSS needs to state the theory underlying the research and state-specific research results.

Table 5. Sample of the selection of Chemistry publications examined in this investigation.

No	Author(s)	Theory used	Learning output	Research outcome
	Solikhin & Wijanarko (Solikhin & Wijanarko, 2021)	It does not elaborate	The findings of five SHS chemistry teachers' assessments were Very Good, with a mean score of 3.31. According to the results of this evaluation, the Chemdroid learning media is appropriate for use as a thermochemistry learning medium. In comparison, the reading test scores of 16 pupils from four SHS yielded Good criterion with a median score of 3.24. This media is appropriate and beneficial for kids from a variety of backgrounds.	The Implementation of Chemdroid has a significant difference.

No	Author(s)	Theory used	Learning output	Research outcome
	Lubis & Ikhsan (Lubis & Ikhsan, 2015)	motivasi belajar dan prestasi kognitif	According to the findings of this study, Android-based chemistry media for learning is acceptable and helpful for use in chemistry education.	Students that participate in learning utilizing Android-based chemical learning media in conjunction with traditional schooling show a considerable improvement in learning motivation and cognitive success. Android-based chemistry learning media on solubility material influences increasing the academic achievement of HSS.
	Yektyastuti & Ikhsan (Yektyastuti & Ikhsan, 2016)	It does not elaborate	ABLM of chemistry on the developed solubility material is considered feasible to use	ABLM can improve HSS' chemistry PS abilities.
	Fatma & Partana (Fatma & Partana, 2019)	PS ability	ABLM is effectively used as a learning medium.	CBG games media improves learners' CTS
	Wardani et al. (Wardani et al., 2017)	critical thinking	The Android-based Chemistry Board Game (CBG) games interactive media on the alkane-derived compound material results in very valid	The elements of concise nomenclature rules and self-check tasks in learning media
	Kurniawan et al. (Kurniawan et al., 2022)	Does not elaborate	The created mobile app substantially increases children's understanding of inorganic chemical nomenclature.	

No	Author(s)	Theory used	Learning output	Research outcome
	Zamhari et al. (Zamhari et al., 2021)	It does not elaborate	The interactive Android-based instructional module featuring three chemical representations of salt hydrolysis material was produced effectively and may be widely tested in SHS.	encourage students' active exploration and self-study. The produced medium filled a substantial demand for interactive chemistry teaching materials with three layers of chemical representation, particularly in salt hydrolysis material.

Table 5 shows a sample of the ABLM development research for the Chemistry subject. Of the 14 articles selected in the chemistry subject, 50% of the articles stated their research output specifically, namely Hidayah & Rahmanah (Hidayah & Rahmanah, 2019), Ayona & Hidayah (Ayona & Hidayah, 2021), Tri et al. (Putra & Kartini, 2020)Kartini et al. (Kartini & Putra, 2020), S. A. Sari & Lubis (S. A. Sari & Exaudie Lubis, 2021), Yamtinah et al. (Yamtinah\* et al., 2022), Rasyid & Partana (Al Rasyid & Partana, 2021). At the same time, 9 out of 14 articles did not state the theory underlying their research, namely Solikhin & Wijanarko (Solikhin & Wijanarko, 2021), Yektyastuti & Ikhsan (Yektyastuti & Ikhsan, 2016), Kurniawan et al. (Kurniawan et al., 2022), Tri et al. (Putra & Kartini, 2020), Kartini et al. (Kartini & Putra, 2020), S. A. Sari & Lubis (S. A. Sari & Exaudie Lubis, 2021), Yamtinah et al. (Yamtinah\* et al., 2022), Rasyid & Partana (Al Rasyid & Partana, 2021), and Zamhari et al. (Zamhari et al., 2021). However, Table 5 also states nine articles describing their research output as an example of research that says specific research output. Solikhin & Wijanarko (Solikhin & Wijanarko, 2021) state that was implementing Chemdroid has a significant difference. Lubis & Ikhsan (Lubis & Ikhsan, 2015) also stated a considerable increase between learning motivation and cognitive achievement of students who took part in learning using Android-based chemistry learning media with conventional education.

In addition, from 14 articles related to chemistry subjects, there were only three studies that stated the theory used in their research, namely Lubis & Ikhsan noted the idea of learning motivation and cognitive achievement (Lubis & Ikhsan, 2015), Fatma & Partana used the problem solving ability theory (Fatma & Partana, 2019), and Wardani et al. (Wardani et al., 2017) used the concept of critical thinking in developing CBG media games. Because chemistry is the subject that is most researched in ABLM development research at the high school level, there are quite a number of studies that state specific research outputs.

Table 6. A summary of the selection of mathematics subject publications

No.	Authors	Theory used	Learning output	Research outcome
	Apsari & Rizki (Apsari & Rizki, 2018)	Does not elaborate	The developed learning media fulfilled the With an average proportion of 84.5%, this is a very viable category, which means that created learning media was very valid. The small group trials were obtained that the response of the students who numbered ten students with an average of 88.1% stated firmly agree, which means learning media developed was very practical	makes it easy for students to study independently and repeatedly to understand wherever and whenever.
	Destiniar et al. (Destiniar et al., 2021)	It does not elaborate	ABLM applications that have been developed are accurate, practical, and effective.	It is not specified
	Widyatama & Pratama (Widyatama & Pratama, 2022)	It does not elaborate	Mobile Learning applications developed are valid, practical and effective.	It is not specified
	Akbar et al. (Akbar et al., 2022)	It does not elaborate	PBL using the STEAM technique, aided by an android integration, successfully increases SHS's mathematical PS skills on sequences and series content.	The PBL model with the STEAM method, aided by the Android, increased mathematical PS abilities.

Table 6 shows a sample of ABLM development research for mathematics subjects. Table 6 shows that 2 of the 4 ABLM development studies for mathematics subjects have not stated specific research outputs. In addition, ABLM development research for mathematics subjects has not noted the basic theory used. Some researchers, Apsari & Rizki (Apsari & Rizki, 2018) and Akbar et al. (Akbar et al., 2022), indicated their research output expressly. Akbar et al. (Akbar et al., 2022) stated that The PBL paradigm with the STEAM approach aided by Android boosted mathematical PS ability. Apsari & Rizki (Apsari & Rizki, 2018) said that ABLM allows students to learn independently and regularly to get it wherever and whenever they decide.

The implications of this literature review will trigger the birth of better and more comprehensive studies that use supporting theories and pay attention to the products being developed and the research outcomes of the products being designed.

This research is limited to 32 articles that meet the requirements for review. The number of reports is insufficient to represent research on developing ABLM for HSS in Indonesia. However, this research provides a new perspective on this topic. In addition, the research data search was carried out from October to November 2022. Meanwhile, ABLM development research from December 2022 until now continues. So

further research on learning media based android is urgently needed. or example android-based learning media in mathematics, physics, biology, economics, and accounting. In addition, there are opportunities to develop learning media at the elementary and high school levels.

## CONCLUSION

Based on the previously discussed findings and argument, it is possible to conclude that the trend of ABLM development research in Indonesia in the last eight years (2015-2022) has continued to increase. The ADDIE model has been the most widely used RnD method in the previous eight years. The questionnaire is the most dominant data collection tool used in Indonesia. The most researched subject related to research on developing ABLM in Indonesia is chemistry. The Indonesian Science Education Journal is the journal that has contributed the most to publishing ABLM development articles. The theory used in ABLM development research is problem-solving, critical thinking, and self-diagnosis skills. The study indicates that ABLM influences PS abilities, critical thinking, and self-diagnosis.

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## AUTHOR CONTRIBUTION STATEMENT

Author Contributions, YND: Conceptualization, Drafting, Editing, Method, and Visualization, HD: Reviewing & Editing, and Formal analysis, OD: Validation and Supervision, RE: Editing and Supervision.

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