JPPIPA 10(5) (2024)

Jurnal Penelitian Pendidikan IPA

Journal of Research in Science Education

http://jppipa.unram.ac.id/index.php/jppipa/index

Development Research in Science Education: A Systematic Literature Review of Trends in Development Models and Instruments Used

Ratih Komala Dewi[1,5], Darmanella Dian Eka Wati[1,5], Oria Lasmana[1], Yerimadesi[2*], Festiyed[3], Yuni Ahda[4], Heffi Alberida[4]

[1] Doctor of Science Education, FMIPA, Universitas Negeri Padang, Padang, Indonesia.
[2] Chemistry Department, Faculty of Mathematics and Natural Science, Universitas Negeri Padang, Padang, Indonesia.
[3] Physics Department, Faculty of Mathematics and Natural Science, Universitas Negeri Padang, Padang, Indonesia.
[4] Biology Department, Faculty of Mathematics and Natural Science, Universitas Negeri Padang, Padang, Indonesia.
[5] Biology Education, Universitas Mahaputra Muhammad Yamin, Solok, Indonesia.

Received: January 7, 2024
Revised: March 2, 2024
Accepted: May 25, 2024
Published: May 31, 2024

Corresponding Author:
Yerimadesi
yeri@fmipa.unp.ac.id

DOI: 10.29303/jppipa.v10i5.6876

Abstract: This study was motivated by the desire to know the trend of development models and instruments used in development research. The purpose of this study was to conduct a comprehensive review of the existing literature on development research in science education. The focus was to identify trends in development models and instruments used in this field. This research is a type of systematic literature review using the PRISMA (Preferred Reporting Items for Systematic reviews and Meta-Analyses) method to look at trends in development models and instruments in science education development research. This research uses Scopus, Science Direct and Eric databases. The results of this study are the most widely used development model is the ADDIE development model and questionnaires are the instruments used in all articles analyzed.

Keywords: Development models; Development research; Instrument; Science education

Introduction

Research in science education has grown rapidly in recent decades, with various models and instruments developed to improve the effectiveness of teaching and learning. One type of research that plays a role in producing various learning products is research development or research and Development (R&D). Research and Development (R&D), is the conception and implementation of new product ideas or improvements to existing products (Winaryati et al., 2021). Development research is a type of research that can connect or break the gap between basic research and applied research (Putra et al., 2020). Development research is a type of educational research that aims to design, implement, and evaluate innovative interventions to improve teaching and learning outcomes. Development research often involves the use of models, which are simple representations of complex phenomena or systems that can facilitate investigation and reasoning. Development research can be applied to a variety of domains, contexts, and objectives, depending on the research question and objectives. The field of science education has made significant progress over the years, with various development models and instruments used to enhance the learning experience.

In order to solve complex educational problems and increase our understanding of the qualities of these interventions and the procedures for creating and developing them, development research designs or develops interventions (such as programs, teaching and

How to Cite:
Dewi, R. K., Wati, D. D. E., Lasmana, O., Yerimadesi, Festiyed, Ahda, Y., & Alberida, H. (2024). Development Research in Science Education: A Systematic Literature Review of Trends in Development Models and Instruments Used. *Jurnal Penelitian Pendidikan IPA*, *10*(5), 250–261. https://doi.org/10.29303/jppipa.v10i5.6876

learning strategies, materials, etc.) (Plomp & Nieveen, 2010).

Research from Karampelas (2021) shows that trends in the field of science education are generally in line with developments in the field of science education, which largely emphasize teaching methods and practices. Researchers publish their journal articles as part of their efforts to disseminate their work, the study of which they write to contribute to the development of their field. Science education is a topic of great interest to educational researchers. The focus is to identify the most appropriate conditions that need to be met by schools, education systems, institutions and society in general, in order to promote scientific literacy. This is important so that learners can understand, critically approach the progress of science and technology and contribute to it.

Development research is particularly relevant for science education, as it can address complex and dynamic challenges in science teaching and learning in a variety of contexts and levels (Plomp & Nieveen, 2010). However, development research in science education is not a homogeneous field, as it involves different models, approaches, and instruments that reflect different assumptions, goals, and outcomes. Although there has been a lot of development research done, there is still a lack of understanding in our understanding of how development models and instruments can best be used in the context of development research in the field of science education.

The development model and its instruments play an important role in science education research. The models provide a framework for designing, implementing, and evaluating educational interventions. The research development model is the framework that guides the process and results of research development. The research development model is flexible, meaning that the stages can be adapted and modified according to the needs and constraints of the research development project.

Research instruments can be interpreted as tools used to collect, measure, and analyze data related to the research topic. Research instruments are tools for researchers to measure natural and social phenomena that are the focus of researchers, specifically all these phenomena are called variables (Hikmawati, 2020). Research instruments have a big role in a study. The main function of research instruments is to measure variables relevant to the research question. So that researchers can collect empirical evidence to answer hypotheses or research objectives. The research instrument used depends on the approach or type of research to be carried out. In choosing a research instrument, a thorough understanding of the research problem, literature, and methodology is required. According to Sofiyana (2022) Research instruments are tools used to collect data systematically and objectively related to the phenomenon under study.

Research instruments must be well designed in order to produce relevant and valid data (Purba et al., 2021). Research instruments can be interpreted as tools used to collect, measure, and analyze data related to the research topic. The research instrument reflects the conceptual framework and operationalization of research variables. Research instruments have a big role in a study. The main function of the research instrument is to measure variables relevant to the research question. So that researchers can collect empirical evidence to answer hypotheses or research objectives. The research instrument used depends on the approach or type of research to be carried out. In choosing a research instrument, a thorough understanding of research problems, literature, and methodology is needed.

The criteria for selecting a good instrument that can be used to assess whether the instrument is a good instrument to use can be done by selecting instruments in the last 5 years and the instrument is widely cited by other authors. The frequency with which this instrument is used by other researchers will provide an indication of support from other researchers. Use by other researchers can provide some evidence of whether the questions on the instrument provide a good and consistent measure. The next criterion is that there is a researcher's review of the use of the instrument. This means that other researchers have taken the instrument seriously and attempted to document its value. In addition, a good instrument has information about the reliability and validity of scores from previous uses of the instrument. The next criterion is that there is a data recording procedure that is appropriate to the research questions in the study and finally, the instrument contains an acceptable measurement scale (Creswell, 2012).

This study reviews what models and instruments are used in science education development research. Models often used in development research such as ADDIE model, 4D model, Plomp model, Borg and Gall model, Dick and Carey model etc. The use of this development model is adjusted to the purpose of the research and the context of the research conducted. Each development model also uses instruments that vary depending on the needs of the research. Such instruments can be interview guidelines, questionnaires, observation sheets, test sheets etc.

Systematic research, literature review related to development models and instruments used in development research has been carried out, but there has been no comprehensive review related to development models and instruments used in development research. This study differs from others in that it will conduct a

systematic literature review of trends in models and instruments used in science education development research. It will provide a clearer and comprehensive picture of the current knowledge base and how it can be improved. This research is expected to provide valuable insights for researchers and educational practitioners about models and instruments in development research that are most effectively used in science research.

Method

The PRISMA (Preferred Reporting Items for Systematic reviews and Meta-Analyses) approach was applied in this study. The steps involved in conducting the literature review were developing the research questions; determining the inclusion and exclusion criteria for the articles; creating a literature search plan; searching for articles in specific databases; assessing the quality of the selected articles based on predefined standards; organizing the data; and interpreting and presenting the findings.

Formulation of research questions, based on the following PICOC: Population (P): Science education researchers and practitioners; Intervention (I): Conducting development research in science education; Comparison (C): Trends in previously used development models and instruments; Outcome (O): Better understanding of trends in development models and instruments used in science education; Context (C): The context of this research is science education.

Article search is focused on title, abstract and keywords. The keyword used in article search is "learning model development in science education". The data base in this study is Eric, Scopus and Science Direct. In Eric's data base, there were 15 articles, Scopus with 356 articles and Science Direct with 17 articles. The total number of articles found was 388 articles and after passing the screening stage of titles, abstracts and keywords relevant to the research topic, 22 articles were obtained for more in-depth analysis.

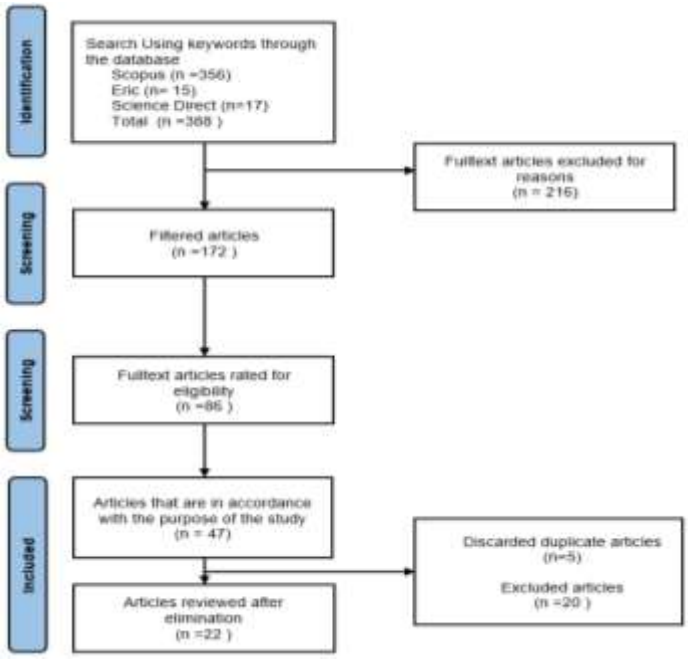

Figure 1. PRISMA method

Table 1. Article Search Protocol

Research Question		What development models are widely used in science education development research What instruments are used in science education development research				
Basis Data		Scopus, Eric, Science Direct				
Research Criteria	Language	English				
	Scientific field	Education				
	Journal	Scopus and Sinta				
	Type of Article	Primary article				
	Search field	Title, Abstract, and Keywords				
	Year of publication	2014-2023				
	Search date	November 28, 2023				
Search Term		Keywords	Eric	Science Direct	Scopus	Total
		"Learning Model Development" AND "Science Education"	15	17	356	388
		Total After removal of duplicate records	15	17	356	388
Inclusion Criteria						Development research article Relevant to the topic Open access
Exclusion Criteria						Conference proceedings, books, non-development articles Not relevant to the topic Not open access
Search Results		Keywords				388
		After abstract review				47
		After article review				22

Result and Discussion

After the screening process, 22 articles were obtained for in-depth analysis, which can be seen in the following table.

Table 2. Article Analysis

Author Name	Year	Country	Heading	Journal Name	Journal Ranking
Yuliastrin et al.	2023	Indonesia	Developing Media of Virtual Laboratory of Science: To Support as a Pioneer of Cyber-University	Contemporary Educational Technology	Q1
Adnan et al.	2023	Malaysia	Development and Usability of STEAM Textbook Integrated Character Education with Local Wisdom Themes for Primary School Students	Journal of Higher Education Theory and Practice	Q1
Chaijalearn et al.	2023	Thailand	Development of Local Wisdom-Based Science Learning Innovation to Promote Creative Problem-solving Skill: Case Study Chessboard Game of Mueang Kung Pottery, Chiang Mai	Journal of Curriculum and Teaching	Q4
Rizqa et al.	2023	Indonesia	The Development of Interactive Multimedia Learning In Vocational School	Mathematics Research and Education Journal	Q4
Novitha & Suhartini	2023	Indonesia	Development of Problem-Based Learning LKPD Based Local Potential of Baros Mangroves in Biology Subjects Environmental Pollution Material	Jurnal Penelitian Pendidikan IPA	Sinta 2
Pakaya et al.	2023	Indonesia	Development of Problem-Based Learning Modules on Environmental Pollution Materials to Improve Student Learning Outcomes	Jurnal Penelitian Pendidikan IPA	Sinta 2
Helen et al.	2023	Indonesia	Problem Based Learning Tools Based on Riau Malay Culture Quadrangular Material and triangle	AKSIOMA: Jurnal Program Studi Pendidikan Matematika	Sinta 2
Amanda et al.	2022	Indonesia	Developing complexity science-problem based learning model to enhance conceptual mastery	Journal of Education and Learning (EduLearn)	Q4
Novitra et al.	2021	Indonesia	Development of Online-based Inquiry Learning Model to Improve 21st-Century Skills of Physics Students in Senior High School	EURASIA Journal of Mathematics, Science and Technology Education,	Q2
Kurniawan et al.	2021	Indonesia	Development of Computer Based Diagnostic Assessment Completed with Simple Harmonic Movement Material Remedial Program	Jurnal Pendidikan Fisika Indonesia	Sinta 2
Subekti & Prahmana	2021	Indonesia	Developing Interactive Electronic Student Worksheets through Discovery Learning and Critical Thinking Skills during Pandemic Era	Mathematics Teaching Research Journal	Q4
Sahrianti et al.	2021	Indonesia	Development of Physics Learning Tools Model Discovery Learning on Momentum and Impulse Material	Jurnal Penelitian Pendidikan IPA	S2
Rahmatsyah & Dwiningsih	2021	Indonesia	Development of Interactive E-Module on The Periodic System Materials as an Online Learning Media	Jurnal Penelitian Pendidikan IPA	S2
Nazar et al.	2021	Indonesia	Developing Instagram-Based E-Poster for Learning the Concept of Alkaline Group of Periodic Table	Jurnal Penelitian Pendidikan IPA	S2

Author Name	Year	Country	Heading	Journal Name	Journal Ranking
Rasiman et al.	2020	Indonesia	Development Of Learning Videos For Junior High School Math Subject To Enhance Mathematical Reasoning	International Journal of Education and Practice	Q3
Susanti et al.	2020	Indonesia	Web-based learning media assisted by powtoon in basic mathematics course	Al-Jabar: Jurnal Pendidikan Matematika	S2
Roswati et al.	2019	Indonesia	The Development of Science Comic in Human Digestive System Topic for Junior High School Students	Journal of science learning	Q4
Syawaludin et al.	2019	Indonesia	Development of Augmented Reality-Based Interactive Multimedia to Improve Critical Thinking Skills in Science Learning	International Journal of Instruction	Q2
Ariyani et al.	2018	Indonesia	Development of photonovela with character education: as An alternative of physics learning media	Scientific Journal of Physics Education Al-BiRuNi	Q4
Serevina et al.	2018	Indonesia	Development of E-Module Based on Problem Based Learning (PBL) on Heat and Temperature to Improve Student's Science Process Skill	TOJET: The Turkish Online Journal of Educational Technology	Q4
Yusandika et al.	2018	Indonesia	Development of Poster Media as a Learning Supplement to Solar System Material Physics	Indonesian Journal of Science and Mathematics Education	S2
Rumansyah et al.	2016	Indonesia	Development of a cooperative learning model of the cooperative type of kosaji in physics learning	Jurnal Penelitian Pendidikan IPA	S2

Descriptive Analysis

Based on the results of a review of 22 articles, it is known that there are 7 articles published in 2023, 1 article in 2022, 6 articles in 2021, 2 articles in 2020, 2 articles in 2019, 3 articles in 2018 and 1 article in 2016. The distribution of the publication year of the article can be seen in the following graph.

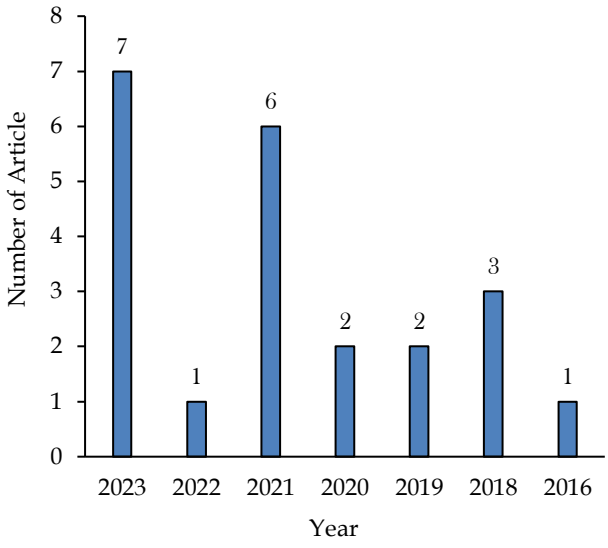

Figure 2. Year of article publication

Based on the distribution of evaluated publications, it can be observed that the writers hail from three different countries: twenty articles are from Indonesia, one from Malaysia, and one from Thailand. The nation that examines the greatest number of articles pertaining to development research is Indonesia. This demonstrates why development research is a popular field among scholars: the end products of development research are anticipated to enhance both human resources and the quality of learning overall. 22 separate journals published the publications that were evaluated. There are several levels in the articles that were analyzed: there are two articles with a Q1 level, two articles with a Q2 level, one item with a Q3 level, seven articles with a Q4 level, and ten articles overall.

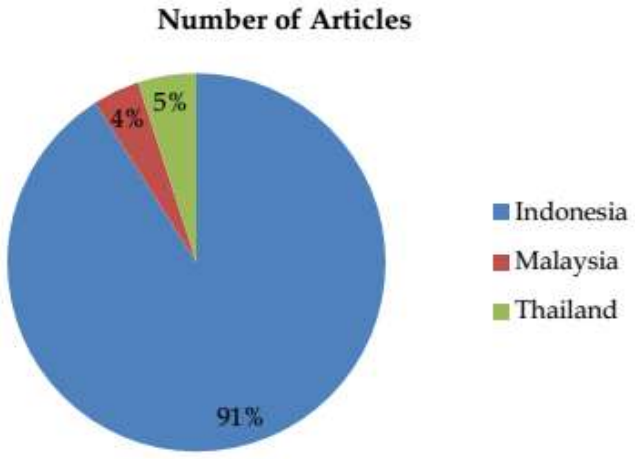

Figure 3. Dissemination of Article Writer's Country

Table 3. Overview of the Development Model and Instruments Used

Author Name	Development Model	Instruments
Yuliastrin et al.	ADDIE Model	Validity sheet, Practicality sheet, and Effectiveness sheet
Adnan et al.	ADDIE Model	Validity sheet and Questionnaire
Chaijalearn et al.	ADDIE Model	Interview, Merit test form, and Satisfaction questionnaire
Pakaya et al.	ADDIE Model	Interview guidelines, Validity sheet, Student response questionnaire, Learning Implementation Sheet, and Pre-test dan post-test
Rasiman et al.	ADDIE Model	Material validity sheet and Media validation sheet
Subekti & Prahmana	ADDIE Model	Electronic student worksheet validation sheets by material experts and media experts Pretest questions, and posttest questions.
Nazar et al.	ADDIE Model	Questionnaire to analyze students' experiences and thoughts about learning media, and Media eligibility assessment sheet to validate emails.
Amanda et al.	Plomp Model	Kusioner, Test, Instrument validity, and Instrument practicality
Novitra et al.	Plomp Model	Validity sheet, practicality sheets, and 21st century skills assessment sheet.
Ariyani et al.	Borg and Gall Model	Observation sheet, Interview guidelines, Expert validity sheet, Educator response sheet, and Student response sheet
Yusandika et al.	Borg and Gall Model	Questionnaire and Scale Likert
Kurniawan et al.	Sukmadinata development model	Product diasnogtic assessment, Product validity sheet, and Product practicality sheet
Syawaludin et al.	Sukmadinata development model	Test, Questionnaire, and Observation Sheet
Serevina et al.	4D Model	Material validity instrument, Media validity instruments, and Kusioner
Novitha & Suhartini	4D Model	Problem-solving ability test questions, Environmental care attitude questionnaire, Expert validation questionnaire, and Student response questionnaire
Sahrianti et al.	4D Model	Test instruments and Validation sheet for expert evaluation and data collection using Likert scale
Helen et al.	4D Model	Instrument of validity and instrument of practicality
Susanti et al.	4D Model	Learning media validation sheet and Student response questionnaire
Rahmatsyah et al.	3D Model	Review sheet and Validation questionnaire
Rizqa et al.	IDI Model	Questionnaire
Roswati et al.	Design and development	Questionnaires and student-teacher implementation test sheets
Rumansyah et al.	Dick and Carey's model	Lesson plan observation sheet, Worksheets, Questionnaire, and Cognitive performance test

Category Analysis

The articles reviewed are articles resulting from development research (R&D) which can be grouped based on the category of development model used. Based on the results of a review of 22 articles, it can be seen that there are 7 articles using the ADDIE model, 2 articles using the Plomp model, 2 articles using the Borg and Gall model, 2 articles using the Sukmadinata model, 5 articles using the 4D model, 1 article using the 3D model, 1 article using the IDI model, 1 article uses the Design and Development model and 1 article uses the Dick and Carey model. This shows that there are variations in the development models used in the field of science education. In education, the products of Research and Development are expected to increase the productivity of education itself (Gustiani, 2019). In general, R&D products in education can include various types of products, such as curriculum, teaching materials, teaching methods, and evaluation tools. These products were developed with the aim of improving the quality of education and student learning outcomes (Mesra, 2023).

Based on the data on Figure 4, it is known that of the 22 articles reviewed, the ADDIE Model is the most widely used development model, which are 7 articles. This model is a framework used to design and develop instruction, and includes the stages of Analysis, Design, Development, Implementation, and Evaluation. The ADDIE model is more widely used because this model has a systematic and responsive approach (Branch, 2009). This means that this ADDIE model has clear steps and can also respond to situations and conditions encountered during the development process. In addition, the ADDIE model is easier to adopt widely because of its flexibility and adaptability, allowing for iterative feedback and continuous improvement. These advantages cause this model to be widely chosen and used by educators and researchers in analyzing and simultaneously solving problems that arise in the field related to learning. In the development process, ethical

considerations must be an integral part of every stage, from requirement determination, design, implementation, to evaluation (Slotfeldt-Ellingsen, 2023).

This is evidenced by the number of researchers using the ADDIE development model such as research conducted by Oksaviona et al. (2023) with the instruments used are validity sheets, the practicality of interactive multimedia sound waves and student response questionnaires. The ADDIE development model was also used by Pakaya et al. (2023) with the instruments used were interview sheets, validation sheets, student response questionnaires, learning implementation sheets (teacher activities), student activities, and pre-test and post-test. Research conducted by Khaulah et al. (2023) used the ADDIE learning model to develop 2D animation learning video media. The instruments used were tests and questionnaires to measure student reactions. Research conducted by Chercules et al. (2023) using the ADDIE development model, with instruments used interviews, questionnaires and tests.

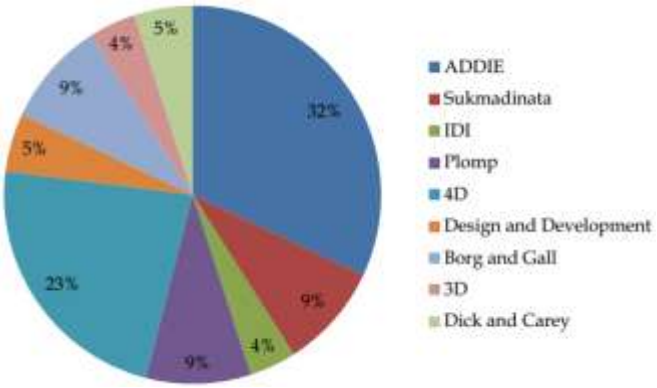

Figure 4. Development model in review article

The research conducted by Qomariyah et al. (2023) used the ADDIE development model with the instruments used were observation sheets, interviews, questionnaires, tests, and documentation. The ADDIE development model was also used by Afian et al. (2023) to develop E-modules using the module validation sheet instrument and module readability sheet. Research conducted by Sugianto et al. (2023) used the ADDIE model with questionnaire instruments, tests and observation sheets. Research conducted by Masaguni et al. (2023) and Harwyandani et al. (2023) using questionnaire instruments, validation sheets, practicality sheets. Research conducted by Fitriani et al. (2015) used the ADDIE model with instruments of observation sheets, interviews, and survey sheets. The steps of the ADDIE model according to (Branch, 2009) can be seen in Figure 5.

The next models chosen were the Plomp, Borg and Gall model, the sukmadina model, the IDI model, the 4D model, the ADI model, the Design and Development model and Dick and Carey. This suggests that there are variations in the approaches used in the development of the field of science education. There are variations of this approach, adjusted to the research objectives, characteristics of the research subject, and research environmental conditions. So it is important for a researcher to analyze these things first before determining what model is suitable for the situation and conditions of the object of study**.** Some problems that may arise in research and development (R&D) include limited resources, difficulties in implementing innovations, measuring R&D results, especially if the results are not immediately visible or difficult to measure keep pace with technological changes, and manage risk (Sa'adah & Wahyu, 2020).

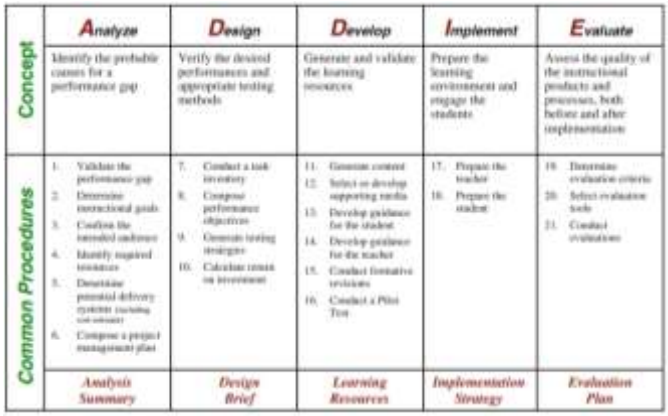

Figure 5. General instructional design procedures organized by ADDIE

Content Analysis

In the context of development research, research instruments may include questionnaires, tests, or other measurement tools used to evaluate the effectiveness of the product or intervention being developed (Saputro, 2021). Based on Table 3, it is known that there is diversity in the use of instruments or diversity in instrument planting. There is one article that does not explain in detail the instruments used and the other twelve articles describe in detail the instruments used. But there are also those who do not explain in detail what instruments are used. Although using the same model, each article writes different instruments according to the needs of the object being developed. Based on the review, it is known that development research with the ADDIE development model (Yuliastrin et al., 2023) uses validity, practicality and effectiveness instruments in the development of the IPA virtual laboratory to determine the validity, practicality and effectiveness of IPA virtual laboratory development products, while Adnan et al.

(2023) using validation sheets to determine the validity of products and questionnaires (without explaining the purpose of using the questionnaire).

Articles written by Chaijalearn et al. (2023) using interview instruments to determine local wisdom in Chiang Mai Province, learning achievement tests on scientific knowledge and local wisdom of pottery in Ciang Mai Province (before and after learning) and questionnaires on student satisfaction with science learning innovations based on local wisdom. Pakaya et al. (2023) also uses the ADDIE model with instruments in the form of interview guidelines, validity sheets, student response questionnaires and pretest and posttest learning implementation sheets. While Rasiman et al. (2020) only use material and media validation sheets as instruments. (Subekti & Prahmana, 2021) using validation sheets of material experts and media experts as well as pretest and posttest questions. Then, Nazar et al. (2021) use an instrument in the form of a questionnaire to analyze students' experiences and thoughts about learning media feasibility assessment sheet.

In contrast to the use of instruments in research with the plomp development model using student response questionnaire instruments, tests, validity and practicality instruments (Amanda et al., 2022). While Novitra et al. (2021) using instruments in the form of validity sheets, practicality sheets and 21St century skill assessment sheets. Instruments of validity include the validity of content, constructs, and languages. Teachers and students evaluate each other's responses to learning models using practicality instruments. The factors include how simple it is to follow the learning paradigm, how helpful e-books are for learning physics, and how well they fit into time management. In the meantime, performance evaluations and peer assessments will be used to gauge the efficacy of the inquiry learning approach based on the model acquired from the 21st Century Skills Assessment tool.

Review of development articles using the Borg and Gall development model, Ariyani et al. (2018) using observation sheet instruments, interview guidelines to obtain initial information related to research plans, and material expert validation questionnaires, media expert validation questionnaires to validate development products as well as educator responses and student responses after product trials. Yusandika et al. (2018) using an instrument in the form of a questionnaire with a Likert scale.

The advantage of this Borg and Gall model is that each stage is carried out systematically and sequentially, thus ensuring that every aspect of the product has been inspected and repaired before launch. In the context of research, this model can be used to develop and test new products at different scales, ranging from initial field trials with a small number of subjects to primary field trials with more subjects. However, the drawback of this model is that the process can become quite lengthy and time-consuming, especially if there are many revisions that need to be made to the product (Maydiantoro, 2021). The Borg and Gall model provides a structured and systematic framework for conducting research and development, it assists researchers in planning, executing and evaluating their research more effectively. Flexible enough to be adapted to different types of research and contexts. The Borg and Gall model is designed to deal with complex and multifaceted research problems. This allows researchers to explore problems from multiple angles and develop comprehensive solutions. Borg and Gall's model uses an iterative approach, in which the results of each stage of research are used to refine the next stage. This ensures that research is continuously improved throughout the process. The Borg and Gall model emphasizes the importance of careful data collection and analysis. This ensures that the research is evidence-based and the results are trustworthy. The Borg and Gall model has been used extensively in many fields, including education, psychology, and other social sciences. This demonstrates the effectiveness and reliability of this model (Gall & Borg, 1989).

In the Sukmadinata development model, Kurniawan et al. (2021) using product diagnostic assessment instruments, product validation sheets, product practicality sheets. While Syawaludin et al. (2019) using tests to measure students' critical thinking skills, validity instruments include the validity of aspects of learning, programming, display, and observation sheets. In the use of the 4D model, the instruments used are material validation, media validation and questionnaires (Serevina et al., 2018). The instruments used by Novitra et al. (2021) are in the form of problem-solving ability test questions, environmental advance attitude questionnaires, expert validation questionnaires and student response questionnaires. Then Sahrianti et al. (2021) use test instruments, validation sheets for expert assessment and data collection using Likert scale. While Heleni et al. (2023) using instruments of validity and practicality.

The instruments used were media validation sheets and student response questionnaires (Susanti et al., 2020). While Rahmatsyah et al. (2021) using a 4D model modified into a 3D model with instruments in the form of review sheets and validation questionnaires. For the IDI model, Rizqa et al. (2023) uses expert validation instruments and media to validate product development, and measurement instruments for the effectiveness of learning outcomes. While the design and

development model used by Roswati et al. (2019) the instrument is in the form of science comic assessment instruments and student-teacher implementation test sheets. The Dick and Carey model used by Rumansyah et al. (2016) in the form of lesson plan observation sheets, worksheets, questionnaires and cognitive achievement tests.

The results of the analysis on twenty-two articles all used questionnaire instruments. This is consistent with the notion Cohen et al. (2000) that questionnaires are a popular and effective tool for gathering survey data; they offer structured data, frequently numerical data, can be delivered when the researcher is not present, are frequently more searcher-friendly, and are generally straightforward to interpret.

Interview instruments were used in 3 articles, observation sheets in 4 articles, student response sheets in 10 articles, tests as many as 8 articles, student-teacher implementation test sheets as many as 1 article. Skill assessment on 1 article and product diasnogic assessment on 1 article. Most articles (6 articles) state the test of validity, practicality and effectiveness. This shows that the selection of development models and the selection of instruments in development research are adjusted to the needs and conditions of researchers.

Conclusion

Based on the literature review study conducted on several primary articles, it can be concluded that there are various development models used by development research researchers including ADDIE, IDI, Plomp, 4D, Borg and Gall and Sukmadinata research and development models. The most widely used development research model is the ADDIE model. As for the instruments used vary from questionnaires, observation sheets, validation sheets, practicality sheets and interview guidelines. The most widely used instrument is the questionnaire.

Acknowledgments
The author is very grateful for all the dedication that has helped to complete this article especially to the lecturers of the Science Education Research Instrument Development course Universitas Negeri Padang.

Author Contributions
In completing the research, seven authors contributed, namely R. K. D, D. D. E. W, O. L contributed in collecting, screening and analyzing research data, While Y writing, review and editing, F, Y. A dan H. A checked and made corrections to this article. All authors have read and agreed to the published version of the manuscript.

Funding
This research received no external funding.

Conflicts of Interest
The authors declare no conflict of interest.

References

Adnan, M., Ahmad, C. N. C., Ibharim, L. F. M., Khalid, F. A. M., Prihaswati, M., Khasanah, U., & Hidayat, R. (2023). Development and Usability of STEAM Textbook Integrated Character Education with Local Wisdom Themes for Primary School Students. *Journal of Higher Education Theory and Practice*, *23*(5). https://doi.org/10.33423/jhetp.v23i5.5925

Afian, T., & Sahratullah, S. (2023). Development of Biology E-Module Based on Integrated Inclusion of Pancasila Student Profiles. *Jurnal Penelitian Pendidikan IPA*, *9*(12), 11024–11028. https://doi.org/10.29303/jppipa.v9i12.5598

Amanda, F. F., Sumitro, S. B., Lestari, S. R., & Ibrohim, I. (2022). Developing Complexity Science-Problem Based Learning Model to Enhance Conceptual Mastery. *Journal of Education and Learning (EduLearn)*, *16*(1), 65–75. https://doi.org/10.11591/edulearn.v16i1.20408

Ariyani, F., Nayana, T., Saregar, A., Yuberti, Y., & Pricilia, A. (2018). Development of Photonovela with Character Education: as an Alternative of Physics Learning Media. *Jurnal Ilmiah Pendidikan Fisika Al-Biruni*, *7*(2), 227–237. https://doi.org/10.24042/jipfalbiruni.v7i2.3072

Borg, W. R., & Gall, M. D. (1989). *Educational Research. An Introduction* (5th ed.). New York: Longman.

Branch, R. M. (2009). *Instructional Design: The ADDIE Approach*. New York: Springer. https://doi.org/10.1007/978-0-387-09506-6

Chaijalearn, Y., Ratchawet, A., Sappan, P., Thanaparn, N., Kaensongsai, J., & Intharawiset, T. (2023). Development of Local Wisdom-Based Science Learning Innovation to Promote Creative Problem-solving Skill: Case Study Chessboard Game of Mueang Kung Pottery, Chiang Mai. *Journal of Curriculum and Teaching*, *12*(3), 58–69. https://doi.org/10.5430/jct.v12n3p58

Chercules, C., Ismet, I., & Sriyanti, I. (2023). Development of Electronic Books Using Website 2 APK Builder Pro Based on Science, Technology, Engineering, and Mathematics (STEM) to Improve Learning Outcomes. *Jurnal Penelitian Pendidikan IPA*, *9*(11), 9381–9390. https://doi.org/10.29303/jppipa.v9i11.5182

Cohen, L., Manion, L., & Morrison, K. (2000). *Research Methods in Education* (5th Edition). London: Routledge Falmer. http://dx.doi.org/10.4324/9780203224342

Creswell, J. W. (2012). *Educational Research: Planning, Conducting, and Evaluating Quantitative and Qualitative Research* (4th ed.). Boston, MA: Pearson Education, Inc.

Fitriani, V., Ahda, Y., & Lufri, L. (2015). Pengembangan Media Pembelajaran Interaktif Berorientasi Konstruktivisme pada Materi Gastrulasi dalam Mata Kuliah Perkembangan Hewan. *Kolaboratif*, *2*(2), 70-81. Retrieved from https://ejournal.unp.ac.id/index.php/kolaboratif/article/view/4972/0

Gustiani, S. (2019). Research and Development (R&D) Method as a Model Design in Educational Research and Its Alternatives. *Holistics Journal Hospitality and Linguistics*, *11*(2), 12–22. Retrieved from https://jurnal.polsri.ac.id/index.php/holistic/article/view/1849

Harwyandani, L. P., & Suyono, S. (2023). Development of Argumentation Skills Test Instruments on Buffer Solutions in Daily Life. *Jurnal Penelitian Pendidikan IPA*, *9*(12), 10705–10714. https://doi.org/10.29303/jppipa.v9i12.4725

Heleni, S., Saragih, S., & Lubis, N. (2023). Perangkat Pembelajaran Problem Based Learning Berbasis Budaya Melayu Riau Materi Segi Empat dan Segi Tiga. *AKSIOMA: Jurnal Program Studi Pendidikan Matematika*, *12*(1), 860. https://doi.org/10.24127/ajpm.v12i1.6505

Hikmawati, F. (2020). *Metodologi Penelitian*. Depok: Rajawali Pers.

Karampelas, K. (2021). Trends on Science Education Research Topics in Education Journals. *European Journal of Science and Mathematics Education*, *9*(1), 1–12. https://doi.org/10.30935/scimath/9556

Khaulah, S., Novianti, N., & Abdullah, T. R. (2023). Development of 2D Animation Learning Video Media for the TAPPS Learning Model to reduce Mathematics Phobia. *Jurnal Penelitian Pendidikan IPA*, *9*(11), 9509–9515. https://doi.org/10.29303/jppipa.v9i11.4962

Kurniawan, B. R., Kusairi, S., Puspita, D. A., & Kusumaningrum, R. W. (2021). Development of Computer Based Diagnostic Assessment Completed with Simple Harmonic Movement Material Remedial Program. *Jurnal Pendidikan Fisika Indonesia*, *17*(1), 1–12. https://doi.org/10.15294/jpfi.v17i1.18540

Masaguni, A. N., Lamangantjo, C. J., Katili, N., Pikoli, M., Buhungo, T. J., & Payu, C. S. (2023). Development of Science Learning Modules Based on Project Based Leraning on Additives and Addictive Substances (A Research in Class VIII SMP Negeri 7 Telaga Biru). *Jurnal Penelitian Pendidikan IPA*, *9*(12), 10758–10767. https://doi.org/10.29303/jppipa.v9i12.5731

Maydiantoro, A. (2021). Model-Model Penelitian Pengembangan (Research and Development). *Jurnal Pengembangan Profesi Pendidik Indonesia (JPPPI)*. Retrieved from http://repository.lppm.unila.ac.id/43959/1/ARTICLE%20JPPPI.pdf

Mesra, R. (2023). *Research & Development dalam Pendidikan*. https://doi.org/10.31219/osf.io/d6wck

Nazar, M., Rahmayani, R. F. I., Aida, D., & Puspita, K. (2021). Developing Instagram-Based E-Poster for Learning the Concept of Alkaline Group of Periodic Table. *Jurnal Penelitian Pendidikan IPA*, *7*(3), 458–463. https://doi.org/10.29303/jppipa.v7i3.733

Novitha, N., & Suhartini, S. (2023). Development of Problem-Based Learning LKPD Based Local Potential of Baros Mangroves in Biology Subjects Environmental Pollution Material. *Jurnal Penelitian Pendidikan IPA*, *9*(12), 10538–10545. https://doi.org/10.29303/jppipa.v9i12.5695

Novitra, F., Festiyed, F., Yohandri, Y., & Asrizal, A. (2021). Development of Online-Based Inquiry Learning Model to Improve 21st-Century Skills of Physics Students in Senior High School. *Eurasia Journal of Mathematics, Science and Technology Education*, *17*(9), 1–20. https://doi.org/10.29333/ejmste/11152

Oksaviona, V., Islami, N., & Nasir, M. (2023). Development of PBL-Based Sound Wave Interactive Multimedia Using Lumi for Class XI High School Students. *Jurnal Penelitian Pendidikan IPA*, *9*(10), 8008–8015. https://doi.org/10.29303/jppipa.v9i10.4426

Pakaya, S. Y. C., Dama, L., Hamidun, M. S., Nusantari, E., Baderan, D. W. K., & Katili, A. S. (2023a). Development of Problem-Based Learning Modules on Environmental Pollution Materials to Improve Student Learning Outcomes. *Jurnal Penelitian Pendidikan IPA*, *9*(10), 7803–7809. https://doi.org/10.29303/jppipa.v9i10.4323

Plomp, T., & Nieveen, N. (2010). An Introduction to Educational Design Research. In *Educational Design Research*. Enschede, the Netherlands: SLO. Retrieved from https://search.app.goo.gl/aKk1a8p

Purba, Y. O., Fadhilaturrahmi, F., Purba, J. T., & Siahaan, K. W. A. (2021). *Teknik Uji Instrumen Penelitian Pendidikan*. Bandung: Widina Bhakti Persada. Retrieved from https://www.researchgate.net/publication/358857481

Putra, D. D., Okilanda, A., Arisman, A., Lanos, M. E. C., Putri, S. A. R., Fajar, M., Lestari, H., & Wanto, S.

(2020). Kupas Tuntas Penelitian Pengembangan Model Borg and Gall. *Wahana Dedikasi: Jurnal PkM Ilmu Kependidikan*, *3*(1). https://doi.org/10.31851/dedikasi.v3i1.5340

Qomariyah, N., & Pertiwi, K. R. (2023). Development of E-Modules Assisted by Smart Apps Creator on Reproductive System Material to Improve Cognitive Abilities and Self-Awareness Attitudes towards Reproductive Health of Class XI SMA/MA Learners. *Jurnal Penelitian Pendidikan IPA*, *9*(11), 9063–9074. https://doi.org/10.29303/jppipa.v9i11.4924

Rahmatsyah, S. W., & Dwiningsih, K. (2021). Development of Interactive E-Module on The Periodic System Materials as an Online Learning Media. *Jurnal Penelitian Pendidikan IPA*, *7*(2), 255. https://doi.org/10.29303/jppipa.v7i2.582

Rasiman, R., Prasetyowati, D., & Kartinah, K. (2020). Development of Learning Videos for Junior High School Math Subject to Enhance Mathematical Reasoning. *International Journal of Education and Practice*, *8*(1), 18–25. https://doi.org/10.18488/journal.61.2020.81.18.25

Rizqa, M., Husni, R., & Rahmi, U. (2023). The Development of Interactive Multimedia Learning in Vocational School. *Mathematics Research and Education Journal*, *7*(2), 14–24. https://doi.org/10.25299/mrej.2023.vol7(2).14496

Roswati, N., Rustaman, N. Y., & Nugraha, I. (2019). The Development of Science Comic in Human Digestive System Topic for Junior High School Students. *Journal of Science Learning*, *3*(1), 12–18. https://doi.org/10.17509/jsl.v3i1.18120

Rumansyah, R., Kosim, K., & Soepriyanto, H. (2016). Pengembangan Model Pembelajaran Kooperatif Tipe KOSAJI pada Pembelajaran Fisika. *Jurnal Penelitian Pendidikan IPA*, *2*(2). Retrieved from http://jppipa.unram.ac.id/index.php/jppipa

Sa'adah, R. N., & Wahyu, W. (2020). *Metode Penelitian R&D (Research and Development) Kajian Teoretis dan Aplikatif*. Malang: Literasi Nusantara.

Sahrianti, I., Taufik, M., Gunada, I. W., & Doyan, A. (2021). Development of Physics Learning Tools Model Discovery Learning on Momentum and Impulse Material. *Jurnal Penelitian Pendidikan IPA*, *7*(3), 370–374. https://doi.org/10.29303/jppipa.v7i3.580

Saputro, B. (2021). *Best Practices Penelitian Pengembangan (Research and Development) Bidang Manajemen Pendidikan IPA*. Academia Publication. Retrieved from https://play.google.com/store/books/details/Best_Practices_Penelitian_Pengembangan_Research_De?id=htcrEAAAQBAJ&hl=id&gl=ID

Serevina, V., Sunaryo, S., Raihanati, R., Astra, I. M., & Sari, I. J. (2018). Development of E-Module Based on Problem Based Learning (PBL) on Heat and Temperature to Improve Student's Science Process Skill. *TOJET: The Turkish Online Journal of Educational Technology*, *17*(3), 26-36. Retrieved from https://eric.ed.gov/?id=EJ1184205

Slotfeldt-Ellingsen, D. (2023). *Professional Ethics for Research and Development Activities*. Springer International Publishing. https://doi.org/10.1007/978-3-031-25484-0

Sofiyana, M. S. (2022). Metodologi Penelitian Pendidikan. In Aryanto (1st Eds.), *Metodologi Penelitian Pendidikan Kualitatif*. Padang: PT. Global Eksekutif Teknologi. Retrieved from www.globaleksekutifteknologi.co.id

Subekti, M. A. S., & Prahmana, R. C. I. (2021). Developing Interactive Electronic Student Worksheets through Discovery Learning and Critical Thinking Skills during Pandemic Era. *Mathematics Teaching Research Journal*, *13*(2). Retrieved from http://files.eric.ed.gov/fulltext/EJ1383140.pdf

Sugianto, S., Liunokas, A. B., Listari, N., Dewi, N. P. Y. A., Rasyid, A., & Chaidir, D. M. (2023). Development of Human Reproductive System E-Module Teaching Materials Using the Flip Pdf Corporate Application. *Jurnal Penelitian Pendidikan IPA*, *9*(12), 10965–10972. https://doi.org/10.29303/jppipa.v9i12.4573

Susanti, V. D., Andari, T., & Harenza, A. F. (2020). Web-Based Learning Media Assisted by Powtoon in Basic Mathematics Course. *Al-Jabar: Jurnal Pendidikan Matematika*, *11*(1), 11–20. Retrieved from http://ejournal.radenintan.ac.id/index.php/al-jabar/index

Syawaludin, A., Gunarhadi, G., & Rintayati, P. (2019). Development of Augmented Reality-Based Interactive Multimedia to Improve Critical Thinking Skills in Science Learning. *International Journal of Instruction*, *12*(4), 331–344. https://doi.org/10.29333/iji.2019.12421a

Winaryati, E., Munsarif, M., Mardiana, M., & Suwahono, S. (2021). *Cercular Model of RD&D (Model RD&D Pendidikan dan Sosial)*. Jakarta: IKAPI.

Yuliastrin, A., Vebrianto, R., Berlian, M., & Thahir, M. (2023). Developing Media of Virtual Laboratory of Science: To Support as a Pioneer of Cyber-University. *Contemporary Educational Technology*, *15*(2). https://doi.org/10.30935/cedtech/13032

Yusandika, D. A., & Susilawati, E. (2018). Pengembangan Media Poster sebagai Suplemen Pembelajaran Fisika Materi Tata Surya. *Indonesian Journal of Science and Mathematics Education*, *1*(3).

Retrieved from https://ejournal.radenintan.ac.id/index.php/IJSME/index