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Developing Mobile Learning of Physics (MOBLEP) with android-based problem-based learning approach to improve students' learning independence

Apit Fathurohman*, Murniati, Sukemi, Esti Susiloningsih, Erni, Lintang Auliya Kurdiati, Samsuryadi

Universitas Sriwijaya, Masjid Al Gazali St., Palembang, South Sumatera, 30128, Indonesia
e-mail: apit_fathurohman@fkip.unsri.ac.id
* Corresponding Author.

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Abstract: This development research aims to produce Mobile Learning of Physics (Moblep) by applying Android-based Problem Based Learning Approach to Increase Student Learning Independence which is valid and practical. The development model used is the Rowntree model modified with Tessmer's formative evaluation method. The tessmer's formative evaluation stages in this study include self-evaluation, expert review, one-to-one, and small group. At the expert review stage, data were collected through interviews, expert tests, and questionnaires using nine material experts, nine design experts, and eleven language experts. The one-to-one stage and the small group stage were carried out at SMA Negeri 1 Suak Tapeh. The results showed that the Mobile Learning of Physics (Moblep) with the Android-based Problem-Based Learning Approach that was developed, based on the results of the expert review, obtained a total percentage score of 94.73% from the validator and was included in the "very valid" category. Based on the results of the student response questionnaire at the one-to-one evaluation stage, the average percentage was 83.5%, and at the small group stage, the average percentage was 95.2%, so this Moblep was included in the "very practical" category.The implication of this research is that the results of this study can be applied as reference material and considered as additional references for further research.
Keywords: Mobile Learning; Physics; Problem-Based Learning

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Introduction

The presence of the Minister of Education and Culture of the Republic of Indonesia, Nadiem Makarim, sparked an idea for a change in the curriculum, namely the 'Merdeka' curriculum. The curriculum is one of the curriculum concepts that demands independence for students (Manalu et al., 2022). Independence is an attitude of a person that is acquired cumulatively during development, that person will continuously learn to be independent in dealing with various kinds of situations in the environment, which results in the individual eventually being able to think and act independently (Hartati & Astriningsih, 2020). On the other hand, Sari (2020) states that independence is the ability of students to carry out their own learning process without dependence on teachers, peers, classes, and so on. How much independence a student learns is determined by the level of responsibility and initiative to always play an active role in learning planning, learning process, and learning evaluation (Nurfadilah, 2022). When students play an active role in various kinds of activities, the level of student learning independence will be higher (Cahya et al., 2021; Robiana & Handoko, 2020).

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According to Rasman et al. (2022), there are several important reasons for students' learning independence that are interrelated with the current curriculum, namely that students must be able to face problems in the classroom and outside the classroom (Syaripuddin et al., 2020), which are becoming increasingly complex. Students are also expected to reduce their reliance on learning with others in solving problems in everyday life. Based on this opinion, it can be concluded that students must have an independent attitude during the learning process so that they no longer feel dependent on the teacher which results in the teaching and learning process not being optimal.

Teachers can use educational media to give students opportunity to develop mathematics communication skills and student learning independence since they are aware of the importance of these concepts (Wahyuni & Yolanda, 2021). This is in accordance with the opinion that learning media can make it easier for teachers to teach and make students feel happy and comfortable learning in class (Adzkiya & Suryaman, 2021). Likewise, Widada & Rosyidi (2018) stated in their research that learning media occupy a fairly important position in the learning system. The use of instructional media can improve the limitations of educators in conveying information as well as the limitations of learning hours in class (Budiyono, 2020). Another advantage of using learning media is that it can increase the knowledge and skills of students (Priscylio, 2019). One of the learning media that is currently trending is Android-based mobile learning (Aji et al., 2020).

The term "mobile learning" refers to the use of IT devices and mobility, namely the principle of learning without space and time boundaries (Samsinar, 2020). Mobile media learning is a medium that is delivered through mobile devices that aim to assist the learning process and educational content to gain knowledge regardless of location and time (Ancer et al., 2021). According to Nababan (2020), mobile learning can be defined as a facility or service that offers general information to learners and educational content that supports their acquisition of knowledge regardless of place and time.

One of the mobile learning tools that can be used for learning in the Merdeka Curriculum is MOBLEP (Mobile Learning of Physics) with problem-based learning. Based on research conducted by Fathurohman & Lutfi (2019), the problem-based learning model can be utilized in schools applying Merdeka Curriculum by following existing learning procedures and achievements. MOBLEP itself is a learning media product in the form of mobile learning, which contains three learning materials: vector material, straight motion kinematics, and particle dynamics.

Previous studies have developed a lot of learning media, but not many have developed learning media for mobile learning with a problem-based learning approach, especially in physics subjects, with the aim of increasing student learning independence. Many researchers have worked on the development of mobile learning as a learning medium, including Budyastomo (2020). The results of the study show that this introduction application is very fun, so the material can be well received by students. Based on the description above, and also referring to the findings and results of studies that have been carried out, it is considered very important to develop mobile learning of physics (MOBLEP) with an android-based problem-based learning approach. This research aims to produce Mobile Learning of Physics (MOBLEP) with an Android-based problem-based learning approach to increase student learning independence which is valid and practical.

Method

The method used in this research is development research in producing Mobile Learning of Physics (MOBLEP) with an Android-based Problem-Based Learning Approach to increase student learning independence. The subjects in this study were Mobile Learning of Physics (MOBLEP) with an Android-based Problem-Based Learning Approach to Increase Student Learning Independence of High School students in the one-to-one evaluation and small group evaluation trials. The objects in this study were class XII students of SMA Negeri 1 Suak Tapeh. Researchers used the Rowntree development model in developing Moblep with an Android-based problem-based learning approach to increase student learning independence. The flow of this research design can be seen in the following Figure 1.

Figure 1. Rowntree's Product Development Model Stages

The planning stage, the development stage, and the evaluation stage were the three steps of the Rowntree development research techniques used in this study. The planning phase is the first step in the development research process for MOBLEP. At this point, it is broken down into two sections: needs analysis and learning objectives formulation. The purpose of the needs analysis is to find out what problems or obstacles are encountered in the field regarding learning physics. The researcher formulated the learning objectives based on the flow analysis derived from the learning achievements of phase F physics material.

The second stage is the development stage. The first development stage is topic development, namely the stage of determining the subject matter of learning. At the topic development stage, the researcher chose the subject matter of physics in class XI in phase F and then compiled the structure of the material. Next, a draft is prepared to determine the sequence of learning. After the draft is prepared, it is then completed according to the product being developed. After drafting, the next step is prototype production. Prototype production is underway in order to obtain MOBLEP as planned.

The third stage is the evaluation stage. The evaluation stage is the final stage in the MOBLEP development research. The researcher carried out the evaluation phase by referring to the formative evaluation procedure from Tessmer with four evaluation steps applied, namely: self-evaluation, expert review, one-to-one evaluation, and small group evaluation. Tessmer's formative evaluation design flow can be stated in the following figure 2.

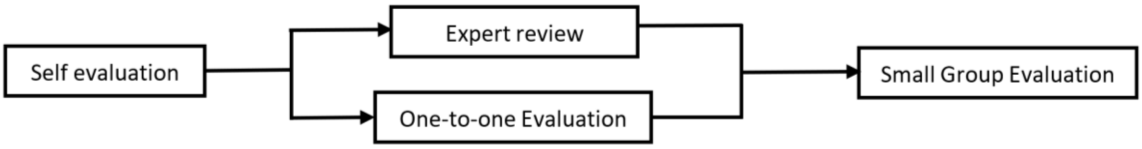

Figure 2. Tessmer's Formative Evaluation Design Flow

At the Self Evaluation stage, the assessment was carried out by the researcher and other research members conducting their own evaluation of the MOBLEP that had been developed by looking at the suitability with the applicable development rules. The results of the MOBLEP (prototype 1) were developed based on self-evaluation, and then the designed MOBLEP was given to experts for validation. At this stage, the development will be evaluated by experts or validators. The validity test that was carried out was to test the validity of the content (material), design, and language against MOBLEP.

In the one-to-one evaluation stage, the researcher selected five students of class XII high school to represent the population. The students were asked to study the material on prototype 1, which has been revised. At the end of the fifth lesson, students were required to fill out a questionnaire that had been given to find out students' responses to prototype 1, which was used in learning. This is done with the aim of seeing the practicality of the MOBLEP from the student's point of view. The responses of students to the One-to-One Evaluation questionnaire will be used to revise the prototype 1, so that prototype 2 can be produced later.

Prototype 2 was tested on a small group (15 participants) of class XII High School students chosen based on varying skill levels throughout the small group evaluation stage. The students looked at Prototype 2. Students completed a questionnaire at the conclusion of the lesson to provide feedback on the usage of prototype 2 in the classroom. The instrument used in this stage is the same as the one-to-one evaluation questionnaire instrument. The purpose of the questionnaire is to test the level of practicality of using the prototype.

Data collection techniques were carried out through the walkthrough stage and the questionnaire stage. The data collection tool used in the walkthrough stage is a validation sheet given to the expert or validator. The content/material validators consisted of 9 people, the design validators consisted of 9 people, and the language validators consisted of 11 people. At the walkthrough stage in the development of this mobile application, it was validated by experts covering content validation, design validation, and language validation. The researcher used a lattice of content and material validation instruments, designs, and languages for MOBLEP, which can be seen in Table 1, Table 2, Table 3.

Table 1. MOBLEP Content Validation Instrument Grid (Material Expert)

No.	Indicators	Statement Number
1.	The existence of elements of science in MOBLEP	1,2
2.	The presence of technological elements in MOBLEP	3,4
3.	The existence of technical elements in MOBLEP	5, 6
4.	The presence of PBL elements in MOBLEP	7,8
5.	Conformity of the material to basic competencies and learning objectives	9,10
6.	The correctness of the substance of the learning material	11,12
7.	Suitability to the needs of learners	13,14
8.	Compatibility with MOBLEP needs	15,16
9.	Benefits for an insight enhancer	17,18

Table 2. MOBLEP Design Validation Instrument Grilles (Media Expert)

No.	Indicators	Statement Number
1.	Order of Presentation	1
2.	Completeness of information	2,3,4
3.	Font usage: types and sizes	5,6
4.	MOBLEP cover and content design	6,7
5.	Lay out	8,9
6.	Illustrations, graphics and drawings	10,11

Table 3. Language Validation Instrument Grids (Linguists)

No.	Indicators	Statement Number
1.	Readability	1,2,3
2.	Conformity with good and correct Indonesian rules	4,5
3.	Clarity of information	6
4.	Effective and efficient use of language (clear and brief)	7,8

The one-on-one evaluation stage and the small group evaluation stage used the questionnaire data collection technique to gather information in the form of student replies, which are subsequently used as a guide when modifying MOBLEP products. Each statement in the questionnaire has a score scale, as well as a recommendation column. The following Table 4 shows the questionnaire instrument grid of students' replies to the utilization of instructional materials:

Table 4. Student Response Questionnaire Instrument Grid for Mobile Use

No.	Indicators	Statement Number
1.	Clarity of instructions for use of MOBLEP	1
2.	Clarity of information	2,3,4
3.	Suitability to the needs of learners	5,6
4.	Motivational provision	7,8
5.	Benefits for an insight enhancer	9
6.	Font usage: types and sizes	10,11
7.	Use of language effectively and efficiently	12
8.	Illustrations, graphics and drawings	13

No.	Indicators	Statement Number
9.	MOBLEP display design	14,15
10.	The presence of PBL on MOBLEP	16,17,18,19

This study makes use of two analytical methods: walkthrough data analysis and questionnaire data analysis. The outcomes of expert walkthrough data analysis will be described in detail in order to provide recommendations for changing the training materials. The validation sheet contains the input. The expert is then provided with a validation sheet in the form of a Likert scale. The checklist-style Likert scale that was utilized had five categories of responses: strongly agree, agree, rather agree, disagree, and strongly disagree, as shown in Table 5.

Table 5. Validation Value Category

Categories Answers	Score Statement
Strongly Agree	5
Agree	4
Rather Agree	3
Disagree	2
Strongly disagree	1

The validation results of the validator will be described in the form of a table, then searched for averages. After that, the average value of the assessment results from the validators obtained was adjusted in several categories, as shown in Table 6 below:

Table 6. Categories of Expert Validation Results

Average	Category
$86 \leq HVA \leq 100$	Highly Valid
$70 \leq HVA < 86$	Valid
$56 \leq HVA < 70$	Less Valid
$0 < HVA < 56$	Invalid

The results of the survey were acquired during the small group and one-to-one evaluation phases, and they were then utilized to evaluate how useful the developed prototype was. The results of the questionnaire were then analyzed using a Likert scale to measure how students think about the use of teaching materials. The data from the questionnaire is presented in the form of a table, and then the percentage is calculated. The questionnaire value is then converted into a percentage form to find out the student's opinion of the developed MOBLEP according to the criteria set out in Table 7 below:

Table 7. Practicality Answer Scoring Criteria

Average	Category
$86 \leq HVA \leq 100$	Very Practical
$70 \leq HVA < 86$	Practical
$56 \leq HVA < 70$	Less Practical
$0 < HVA < 56$	Impractical

Results and Discussion

Planning Stage

In the first planning stage, namely the needs analysis stage, observations and informal interviews were conducted with several high school teachers and students in Palembang City. so that the results are: (1) there is no mobile learning using Merdeka curriculum because this curriculum is the newest and only a few schools have implemented it; (2) the use of Android, which high school students cannot avoid anymore, to support the learning process so that it can make it easier to access appropriate material with MOBLEP; and (3) with the existence of the internet as one of the main necessities, it is not surprising that there are learning resources based on mobile learning via Android.

Based on the results of the interview, it is necessary to have learning media and learning resources for material from the latest curriculum, so that the material obtained is directed and in accordance with the currently developing curriculum. In addition, without appropriate teaching materials, students can experience misconceptions. Therefore, MOBLEP learning resources and media will get to know the real application of physics.

The purpose of learning in the Independent Learning Curriculum is to create fun education, catch up on learning, and develop the potential of students. Based on this learning, the High School level application of physics learning subjects must serve as a vehicle or a method of instructing students in order to enable them to comprehend physics' concepts and tenets. Understanding concepts is emphasized in the learning of physics, but it is also important to include goods, processes or procedures, attitudes, and technologies that may be applied to solve problems that are already present.

Development Stage

There are several development steps that researchers take at this stage, namely topic development, drafting, and prototype production. The topics developed are adapted to the Phase F high school physics teaching module. The description of the material for the development of PBL-based MOBLEP are divided into three steps. The first is the application of vectors, dynamics, and kinematics. The second is the analyses of direction, force, and motion. Lastly, making an outline of the contents of the media as a reference for drafting.

The results of the preparation of the draft that the researchers have done are a storyboard preparation with a clear and complete design of PBL-based MOBLEP learning media and resources based on the GBIM (outline of media content) that has been created. Prototype production is done by displaying the front page of the PBL-based mobile learning application for physics subjects for High School Merdeka Curriculum Phase F. The display on this page says "Welcome MOBLEP Login With," and there is a "Login with Google" button that can be clicked to select a Google account. On the next page a Home screen will appear, with the account name according to the Google account you entered. Next several icons will appear starting with Learning Achievement, Learning Objectives, Learning Objective Flow, Vector, Dynamics, Kinematics, Settings, Home, and Chat. On the Vector, Dynamics, and Kinematics icons, when clicked, there are 12 icons to choose from, ranging from teaching modules, worksheets, quizzes, virtual labs, and BETA physics (*fisika begitu dekat dan nyata*).

Evaluation Stage

The created MOBLEP learning materials and PBL-based media for Class XI Phase F are assessed to determine their validity and applicability. The evaluation strategy is based on Tessmer's formative evaluation model, which has been adapted to include stages for small-group, one-to-one, expert review, and self-evaluation. At the self-evaluation stage, the researchers re-examined the MOBLEP with the PBL approach for class XI, which had been developed so that there were no fundamental errors in the developed mobile learning; at this stage, it was found several navigation buttons that did not work and errors in typing. Then, changes were made in response to the issues found. In the expert review stage, a number of specialists are consulted to confirm the revision's findings. The stage of the expert review is where the developed mobile learning is evaluated for validity. There were nine content/material validators, nine design validators, and eleven language validators. The validation assessment focuses on the following two aspects: material (content) and media (layout). Table 8 displays the findings of the validation performed by professionals.

Table 8. Results of expert validation assessment of PBL-based MOBLEP on Expert Review

Validator (Expert)	Indicators/Aspects Assessed	Average Score	Percentage (%)
Validation 1	The existence of elements of science in MOBLEP	3.36	93
	The presence of technological elements in MOBLEP	3.28	91
	The existence of technical elements in MOBLEP	3.44	96
	The presence of PBL elements in MOBLEP	3.32	90
	Conformity of the material to basic competencies and learning objectives	3.40	90
	The correctness of the substance of the learning material	3.48	97
	Suitability to the needs of learners	3.44	96
	Compatibility with MOBLEP needs	3.20	89
	Benefits for an insight enhancer	3.48	97
Average Aspect of Content		3,37	93.2
Validation 2	Order of Presentation	3.80	95
	Completeness of information	3.80	95
	Font usage: types and sizes	3.85	96
	MOBLEP cover and content design	3.90	98
	Lay out	3.85	96
	Illustrations, graphics and drawings	3.70	93
Average Design Aspects		3,81	95.5
Validation 3	Readability	3.78	95
	Conformity with good and correct Indonesian rules	3.63	91
	Clarity of information	3.92	98
	Effective and efficient use of language (clear and brief)	3.92	98
	Average Linguistic Aspects	3,81	95.5
	Average Total Media Validation	3,66	94.73

Based on Table 8, about the product validity level categories, the average percentage of total MOBLEP assessments with the PBL approach is shown in Table 8, of which 94.73% belongs to the category of "highly valid" and can be used at a later stage of research. Experts provide suggestions for improving MOBLEP with the PBL approach under development, as shown in Table 9 below.

Table 9. Expert Comments and Advice at the Expert Stage on PBL-based MOBLEP

Expert (Validator)	Aspects	Comments and Suggestions
Validator 1	Content Aspects	It has been very good at supporting students' abilities, and it is hoped that in the future other materials can be made. Discussions can also be done through the keyboard feature; add sample questions, add more illustrations. The menu is again difficult to use, so you need patience.
Validator 2	Design Aspects	Complete and easy-to-understand features. Colors can be adjusted again for chat material and features. Pay attention to the initial appearance.
Validator 3	Linguistic Aspects	The words in each paragraph are very clear and easy to understand. Consistency in the use of Indonesian spelling in all writing

In Table 9, it can be seen that there are still comments and suggestions about MOBLEP with the PBL approach for High School Phase F which was developed both in terms of content, language, and media (lay-out). Therefore, it is necessary to revise MOBLEP with the developed PBL approach, then carry out the One-to-one evaluation stage.

One-to-one evaluation aims to see the practicality of the media by using student response sheets. At this stage students are asked to use the developed PBL-based MOBLEP. It involved 5 students majoring in Physics who represented the high, medium and low groups. The results of the student response questionnaire assessment at the one to one evaluation stage show Table 10.

Table 10. The Results of the Student Response Questionnaire Assessment at the One to One Evaluation Stage

Indicators/Aspects Assessed	Average Score	Percentage (%)
Clarity of instructions for use of MOBLEP	3.55	75
Clarity of information	3.87	90
Suitability to the needs of learners	3.48	72
Motivational provision	3.62	78
Benefits for an insight enhancer	3.77	88
Font usage: types and sizes	3.66	85
Use of language effectively and efficiently	3.82	80
Illustrations, graphics and drawings	3.75	83
MOBLEP display design	3.88	92
The presence of PBL on MOBLEP	3.88	92
Overall Average	3.72	83.5%

Based on the data in Table 10, it can be concluded that the overall average recapitulation results of student responses to MOBLEP with the PBL approach of 83.5% are included in the very practical category. In this one-to-one evaluation stage, apart from providing a quantitative assessment, students are also asked to provide a qualitative assessment of this media, namely in the form of comments and suggestions that help the development of this media to be better and more practical. Comments and suggestions given by students can be seen in Table 11.

Table 11. Student comments and suggestions for PBL-based mobile learning in the One-to-One Evolution Stage

No	Name	Comments and Suggestions
1	P.S.W	The media tested is already very good, but the inadequate network makes learning activities a little more difficult.
2	K	In this material, it is very clear and interesting, having a virtual laboratory that is quite helpful in online practicum activities.
3	S. Y	Very helpful and very interesting, the material can be repeated even if there is no teacher.
4	H	Very helpful and interesting
5	N. G	This application is quite good and helps to understand the material at hand.

It was essentially the same in the small group stage as it was in the one-on-one evaluation stage. With a small group of student participants, the researcher assessed prototype 2 using MOBLEP. It involved 15 students at this point, with 5 students from the high group, 5 from the middle group, and 5 from the low group. Students are asked to engage in independent learning and also required to complete a response questionnaire at the conclusion of the small group trial. Table 12 below lists the outcomes of the student response survey.

Table 12. Results of Student Response Questionnaire Assessment at the Small Group Stage

Indicators/Aspects Assessed	Average Score	Percentage (%)
Clarity of instructions for use of MOBLEP	3.52	88
Clarity of information	3.39	85
Suitability to the needs of learners	3.25	81
Motivational provision	3.38	85
Benefits for an insight enhancer	3.36	84
Font usage: types and sizes	3.38	85
Effective and efficient use of language	3.46	87
Illustrations, graphics and drawings	3.46	87
MOBLEP display design	3.49	87
The presence of PBL on MOBLEP	3.52	88
Overall Average	3.41	95.2

According to table 12, the overall average score from the student response survey for prototype 2 of the MOBLEP with the PBL approach was 95.2%, falling into the "very practical" category. In this small group stage, students are also expected to submit a qualitative review of this medium, namely in the form of comments and suggestions that aid in the improvement and practicality of this media. Table 13 contains student feedback and recommendations.

Table 13. Student Comments and Suggestions for PBL-based Mobile Learning in the Small Group Stage

No	Name	Student Comments
1.	R	Self-explanatory and interesting
2.	T. K	It's easy to understand and understand, there are games that keep us entertained, learning while playing.
3.	W. J	The setting is very interesting, useful and easy to understand
4.	F	The application should not be too large in size, my memory fills up quickly
5.	P. J	Very exciting
6.	F. A	This application can help the learning process and is easy to understand
7.	H	Hope the app is offline
8.	F. W	Nice and easy to understand
9.	B. O	Very nice and I can play with this app
10.	D.W. U	Lots of learning and fun materials
11.	R.C	Lots of material and easy to understand
12.	P. P	A lot of information and not monotonous
13.	K.D. A	Easy to understand and fun
14.	I.B	Hopefully it stays even if the network is slow
15.	L.T. P	At the time of the quiz, hopefully it will be biased to see the value in order to be able to evaluate

Several changes were made to prototype 2 in response to the students' suggestions and feedback. The generated MOBLEP was revised in order to make the final result even better using the feedback and recommendations provided by the students throughout the small group evaluation stage.

According to the analysis and discussion, mobile learning powered by Android is suitable for application in physics education. Mobile learning has an effect on academic achievement and student attitudes (Demir & Akpınar, 2018). Based on this research, Mobile learning, in addition to increasing student academic achievement, can also increase student motivation as well. Ardiansyah & Nana (2020) asserts that employing mobile learning applications as a learning aid can boost students' desire and excitement for learning and motivate them to get the most out of their educational experiences.

This research is in line with (Bahri et al., 2020) research with the title "Android-Based Mobile Learning Supported the Independent Learning of Senior High School Students in Covid-19 Pandemic" which results that the developed m-learning media is suitable for supporting independence study of high school students. This research is also in line with research that has been conducted by (Syaputrizal & Jannah, 2019) which resulted in the conclusion that the development of mobile learning for physics lessons can improve or be effective in increasing students' learning independence. Students can learn more easily with the help of an Android-based learning application without having to worry about time or space constraints (Rivai et al., 2021; Ammatulloh et al., 2021; Devarainy et al., 2022).

Conclusion

The research that has been done on Mobile Learning of Physics (MOBLEP) with an Android-based Problem Based Learning Approach to increase student learning independence on vector material, kinematics of straight motion, and particle dynamics. Based on the results of expert validations, it is concluded that the total score percentage of validator is 94.73% and included in the highly valid category. Based on the results of the student response questionnaire at the one-to-one evaluation stage, the average percentage is 83.5% and at the small group stage, the average percentage is 95.2%, so that the total average percentage is obtained 89.35% and included in a very practical category.

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