(JIML) JOURNAL OF INNOVATIVE MATHEMATICS LEARNING
Volume 9, No. 1, March 2026
P-ISSN 2621-4733
E-ISSN 2621-4741
https://dx.doi.org/10.22460/jiml.v9i1.p29484

THE DEVELOPMENT OF APPSHEET-ASSISTED THREE FINGER DIAGNOSTIC TEST INSTRUMENT FOR IDENTIFYING MISCELLANEOS ALGEBRA CONCEPT

Fitri Nur Rahmawati[1], Wahyu Hidayat[2], Usman Aripin[3]
[1]IKIP Siliwangi, Jl. Terusan Jend. Sudirman, Cimahi, Indonesia.
fitrirahmaz27@gmail.com
[2]IKIP Siliwangi, Jl. Terusan Jend. Sudirman, Cimahi, Indonesia.
wahyu.azzam.hidayat@gmail.com
[3]IKIP Siliwangi, Jl. Terusan Jend. Sudirman, Cimahi, Indonesia.
aripin@stkipsiliwangi.ac.id

ARTICLE INFO

Article history:

Received Sep 21, 2025
Revised Sep 26, 2025
Accepted Dec 03, 2025

Keywords:

Three Tier Test
Appsheet
Misconceptions
Algebra
Junior High School

ABSTRACT

Misconceptions are common among students when solving mathematics problems and, if left unaddressed, may hinder their ability to understand the material. This study seeks to design and develop diagnostic test instruments—comprising questions and questionnaires—on algebra topics using the Appsheet application. The objectives are to assess the development process, feasibility, and effectiveness of the instruments, as well as to identify challenges faced during implementation. The research employed a Design Research approach with a development studies type, consisting of two stages: preliminary design and formative evaluation. The instruments underwent a one-to-one trial with three students, a small-group trial with six students, and a field test involving 33 eighth-grade students at SMP Negeri 1 Margaasih. Expert validation rated the instruments as "feasible." Data were gathered through documentation, tests, and interviews. The instruments included 10 three-tier multiple-choice questions, a closed-ended questionnaire with 13 items, and interviews with both teachers and students. Analysis revealed that 3.9% of students understood the concepts, 8.2% exhibited positive misconceptions, 8.4% negative misconceptions, 22.1% general misconceptions, while 57.3% showed no conceptual understanding. These findings demonstrate that the instruments effectively identified algebraic misconceptions. Challenges encountered included limited school facilities for mobile device usage and occasional errors in the application when accessed simultaneously by many users, indicating the need for updates. Nevertheless, the Appsheet-assisted three-tier diagnostic test provides a feasible and promising tool for detecting misconceptions in junior high school algebra learning,

Corresponding Author:
Fitri Nur Rahmawati,
Department of Mathematics Education,
Institut Keguruan dan Ilmu Pendidikan Siliwangi,
Jl. Terusan Jend. Sudirman, Cimahi, Indonesia
Email: fitrirahmaz27@gmail.com

How to Cite:

Rahmawati, F.N., Hidayat, W., & Aripin, U. (2026). The Development of Appsheet-Assisted Three Finger Diagnostic Test Instrument for Identifying Miscellaneos Algebra Concept. *JIML*, 9(1), 67-80.

INTRODUCTION

Mathematics is a science that is closely related to life. According to the National Research Council (NRC), mathematics is fundamental and must be present in every aspect of life, even in defense, health, finance, and business (Siregar, 2017). In line with that, Kusumawardani et

al. (2018) stated that mathematics is the basis for improving all abilities, starting from critical thinking skills to work skills. This is an important requirement that mathematics must be studied by all levels of society, both children and adults. In fact, mathematics is the core of all sciences that should be studied from an early age (Rizki Nurhana Friantini et al., 2020).

However, in reality in the field, mathematics is considered a difficult science for most students. Many do not like it or even avoid it because mathematics has an abstract nature, many formulas, and is theoretical. According to Russefendi in his research, many students still make mistakes in working on simple math problems because they do not understand the basic concepts of mathematics (Novitasari et al., 2016). In line with this, the results of a survey conducted by the Program for International Student Assessment (PISA) showed that students' understanding of mathematical concepts in Indonesia is still low, far below the international average score. This reinforces that the basis of learning mathematics is the ability to understand mathematical concepts (Hoiriyah, 2019).

According to Azis (2019) one of the causes of failure in learning mathematics is that many students do not understand or even misunderstand mathematical concepts. Conceptual errors at one level of education can result in basic misunderstandings up to higher levels of education because mathematics is a subject that is interrelated between one material and another. So that not a few students think that mathematics is difficult because one of the factors is that there are many basic concepts that have not been mastered before which are allowed to continue so that the word misconception appears. In line with Karolin T et al. (2016) that misconception is a part of the conceptual framework that is wrong but is considered correct by students so that repeated errors occur.

One of the mathematics subjects that often has misconceptions, especially among junior high school students, is algebra. Not a few students still do not master and understand the concepts in algebra. In fact, algebra is basic material that must be mastered by students because it will be used again in mathematics lessons at the next level. In line with Hasibuan (2015), algebra is important to learn because it has many contributions in advanced mathematics and everyday life. Even in the research of Malasari & Afifaturrohmaniyyah (2021) that students who have good algebra skills will succeed in further education and have better career opportunities in the future. Therefore, instilling the correct initial concept for algebra material, especially in junior high school students, is very important because it is still basic.

If there is a misconception that continues and is not immediately corrected, it will affect student learning outcomes. According to Rahmawati et al. (2018) there are several stages to overcome student difficulties in learning, namely data collection & processing, diagnosis, prognosis, treatment, and evaluation. The most important stage of the stages above is diagnosis because we must be able to find out first where the difficulties experienced by students lie. In line with Artiawati et al. (2016) there are several ways to overcome misconceptions including identifying, finding causes, and finding solutions to correct misconceptions.

According to Abidin (2019), in general there are several things that often cause misconceptions in students, namely from the students themselves, teachers, textbooks, or from teaching methods. There are several ways to find out students' misconceptions, namely 1) Certainty of Response Index (CRI) is a technique for measuring the level of confidence or certainty of a person in answering each problem. 2) Multiple choice test with open reasoning, in this test students work on multiple choice questions and write down the reasons for the answers they choose. Wrong answers are confirmed by interviews to examine why students choose that mindset. 3) Three tier test. The three-tier test diagnostic test instrument which is a combination of the two-tier test combined with the Certainty Response Index (CRI).

According to Sugiarti & Sukarmin (2019) the three-tier test instrument has the advantage of being able to distinguish between those diagnosed with misconceptions, do not understand the concept or those who understand the concept through student answers accompanied by their level of confidence in answering, so that it is accurate in knowing misconceptions.

Three-tier test is a valid test that can be used efficiently and helps researchers to understand students' reasoning behind their answers without conducting interviews to distinguish misconceptions from lack of knowledge (Fabilla et al., 2023). Three-tier test is one type of diagnostic test that uses misconception identification and conceptual understanding. Three-tier test has three levels, the first level is asking students' knowledge of the concept of a problem through multiple-choice answers. The second level is students' reasoning from the process of answering at the first level. The third level is a question about students' confidence in answering the first and second levels (Mardiyah et al., 2020).

Based on the results of interviews with class VIII teachers of SMP Negeri 1 Margaasih, students often have difficulty in understanding mathematical concepts and applying them in problem solving. These problems can occur because students prefer to memorize formulas so that there is an inaccurate understanding of the concept, incorrect use of concepts, and different interpretations of concepts, this can cause students to experience misconceptions.

Currently we live in an era of advanced technology, it is possible that smartphones that are always carried can be used as an effective and efficient learning system (Hutami et al., 2023), this can be seen from the features in it. The use of this technology must be utilized properly, especially for the learning process in schools. There are still many schools that have not utilized technological developments optimally in terms of data input. The current system can be said to be less effective and efficient because it is done manually using the handwriting method. Processing like this certainly requires a lot of time and energy. In an effort to increase efficiency and effectiveness in managing academic data, especially learning process data, a data-based system is needed that is able to integrate existing data in an application that makes it easier to manage the data. Appsheet is an application that is part of Google Access that is integrated with various cloud data, one of which is integrated with Google Drive. In Google Drive there is a spreadsheet that can be used as online data storage. Appsheet can be used on smartphones or computers so that it is still possible to access this application even if you do not bring a smartphone (Purnomo et al., 2022). Students can use the link to access it so that its use is very practical and easy. Based on interviews conducted with several students and even teachers at SMP Negeri 1 Margaasih, it was found that they had never used an appsheet in the learning evaluation process in any subject. That means the use of an appsheet in a diagnostic test instrument is a novelty.

Based on the above explanation, a three-tier diagnostic test instrument assisted by an appsheet will be developed that can identify misconceptions in junior high school students' algebra material. This research is expected to be an initial research in supporting the Instrument General Diagnostic (IGD) in the development of a mathematical literacy clinic research funded by the 2023 Kedaireka matching fund.

METHOD

This study uses a research design research method. Design Research (DR) is an activity of designing systematic educational interventions consisting of design, development, and evaluation activities aimed at improving or enhancing the quality of educational activities or programs (Putrawangsa, 2019). The research conducted is a development research aimed at developing a three-tier diagnostic test instrument assisted by an appsheet to identify misconceptions in junior high school students' algebra material.

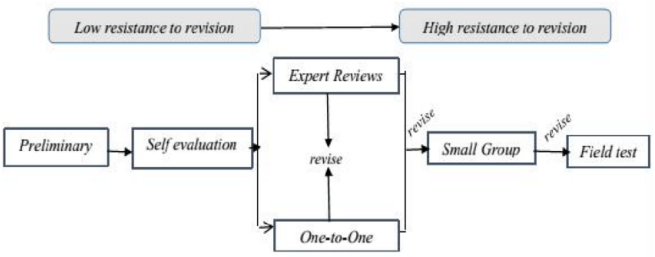


Figure 1. Desain Research Flow

This type of research is included in the design research model of the development studies type which consists of two stages, namely preliminary design and formative evaluation which will be explained as follows:

The preliminary design stage consists of the preparation and development stages. At this stage, analyzing the development of new products (models, methods, media, teaching materials) and analyzing the feasibility and requirements for product development. The development of a product can be initiated by a problem in an existing product. Problems can arise and occur because the existing or available product is no longer relevant to the needs of the target, learning environment, technology, characteristics of students and so on. Product design activities start from the concept to the content in the product is adjusted to the needs in the field.

In the preliminary design stage consists of preparation and development stages. At this stage analyzes the development of new products (models, methods, media, teaching materials) and analyzes the feasibility and requirements of product development. The development of a formative evaluation stage consists of self-evaluation, prototyping (expert review and one-to-one), small group and field test stages. All stages are carried out then revised according to the stages from the results of expert review validation and the results of student response questionnaires and interviews. From the stages passed, the resulting product is valid, practical and has a potential effect on student responses in mathematics learning activities. Spearman rank and Cronbach alpha tests were also carried out using SPSS software to ensure that the validity of this diagnostic instrument media has been tested.

To determine the feasibility of the developed product, product validation is carried out by two lecturers as material experts, one lecturer as a media expert and one teacher as a material expert. The components of the product can be initiated by problems in existing products. Problems can arise and occur because the current or available product is no longer relevant to the needs of the target, learning environment, technology, characteristics of students and so on. Product design activities start from the concept to the content in the product adjusted to the needs in the field. validated includes three-tier diagnostic test instruments and questionnaires as well as diagnostic test instrument media assisted by appsheet.

RESULTS AND DISCUSSION

Results

This Design-Research (DR) method development research was used by researchers in the process of developing a three-tier diagnostic test instrument assisted by an appsheet to identify misconceptions in junior high school students' algebra material. The model used in this study is Design-Research with the type of development studies.

1. Preliminary Design

In the preliminary design stage, researchers carry out the preparation stage and development stage for the product to be made. This preparation or planning stage begins with determining

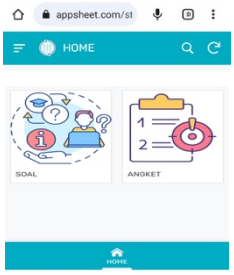
the place and subject of research, arranging the research schedule, and analyzing needs by analyzing the independent learning curriculum. From the results of interviews with teachers, it can be concluded that mathematics learning is still relatively low, there is a lack of student involvement in the learning process and teachers who dominate learning and there are still many students who do not master the material as a whole. If this is allowed to continue and continue, it will cause misconceptions in students' understanding of the material being taught. This will underlie the creation of products or media to identify misconceptions experienced by students.

The next stage carried out by researchers to design and design the initial product, namely starting from topic development, drafting and making prototype 1. When the media or product to be used has been analyzed will use the appsheet media, researchers compile the draft by determining the components written in prototype 1 because the instrument developed is in the form of android-based software, namely appsheet. The following are the components in prototype 1:

Table 1. Prototype 1 Components in Appsheet

No.	Appsheet Components	Explanation
1	Question	Contain questions about self-identity and three-tier diagnostic questions.
2	Questionnaire	Contains self-identity and a questionnaire about the three-tier diagnostic instrument.

After the drafting results, the researcher started production and designed prototype 1 of the diagnostic instrument according to the components in the appsheet by adding background, elements or icons and buttons according to the algebraic material, neat and colored text, menus that are arranged and adjusted to the text so that the appearance of each page is neatly arranged and attractive. The following is the initial design that has been developed:



Picture 1. *Prototype* 1

2. Formative Evaluation

The formative evaluation stage consists of self-evaluation, prototyping (expert review and one-to-one), small group and field test stages.

a. Self-evaluation

At this stage, the researcher with the help of the supervising lecturer assessed and re-examined prototype 1 against the developed diagnostic instrument. After conducting a self-evaluation, the researcher corrected errors in the images and tables in the material, typing of the material, typing of questions containing components of the three-tier diagnostic questions of algebraic material, writing color, background, icons, buttons, and inappropriate elements.

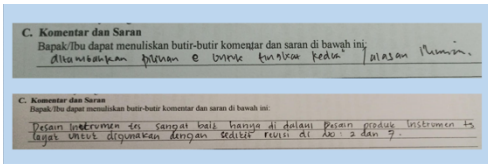
b. Prototyping

This stage consists of 2 parts, namely expert review and one-to-one which are carried out simultaneously.

1) Expert review

This expert review stage is an evaluation stage of the results of prototype 1 which has been developed at the self-evaluation stage, the assessment was carried out by material experts and media experts which was carried out from June 13 to June 20, 2023.

The material expert is referred to as a validator who assesses and provides comments and suggestions related to the content aspects consisting of the content quality aspects and the objectives of prototype 1 by filling out a questionnaire that has been prepared by the researcher. The assessment by the material expert is carried out to determine whether the prototype 1 that has been developed has met the criteria for valid media. Validation was carried out by two lecturers from IKIP Siliwangi, namely Gida Kadarisma, M.Pd and Aflich Yusnita Fitrianna, M.Pd and one mathematics teacher from SMP Negeri 1 Margaasih, namely Komsiatun, S.Pd.


C. Komentar dan Saran
Bapak/Ibu dapat menuliskan butir-butir komentar dan saran di bawah ini.
Alternatif jawaban e untuk kedua alasan rumusnya.

C. Komentar dan Saran
Bapak/Ibu dapat menuliskan butir-butir komentar dan saran di bawah ini:
Desain instrumen ts sangat baik hanya di dalam desain produk instrumen ts lagar untuk digunakan dengan realistik revisi di no: 2 dan 7.

Picture 2. Comments and Suggestions from Subject Matter Experts

There are several things that need to be revised, namely the writing of algebraic forms that must be in accordance with the rules and the addition of option e for open reasons so that students can state reasons from the results of the first choice answers (tier 1) and for numbers 2 and 7 the reasons must be adjusted to the existing answer choices.

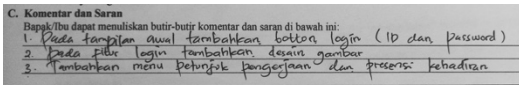
Table 2. Recapitulation of Question Validation Values by Subject Matter Experts

No.	Name of Expert	Recapitulation Value	Coversion Value
1	Subject matter expert 1	70%	B
2	Subject matter expert 2	70%	B
3	Subject matter expert 3	98,5%	A
Average		79,5%	B
Category		Worthy	Worthy

Table 3 Recapitulation of Questionnaire Validation Values by Material Experts

No.	Name of Expert	Recapitulation Value	Coversion Value
1	Material expert 1	87,5%	A
2	Material expert 2	87,5%	A
3	Material expert 3	95,3%	A
Average		90,27%	A
Category		Very Worthy	Very Worthy

Media experts are referred to as validators who assess and provide comments and suggestions related to the technical aspects (design) and language aspects of prototype 1 by filling out a questionnaire that has been prepared by the researcher. The assessment by media experts is carried out to determine whether prototype 1 that has been developed has met the criteria for valid media. Validation was carried out by a mathematics lecturer from IKIP Siliwangi, namely Linda, M.Pd, the results of the media expert validation were used as a reference for revising prototype 1 so that it was declared valid and suitable for use.


C. Komentar dan Saran
Bapak/Ibu dapat menuliskan butir-butir komentar dan saran di bawah ini:
1. Pada tampilan awal tambahkan button login (ID dan password)
2. Pada fitur login tambahkan desain gambar
3. Tambahkan menu petunjuk pengerjaan dan presensi kehadiran

Picture 4. Comments and Suggestions from Media Experts

This diagnostic instrument media was revised according to the advice of experts so that its use is interesting and in accordance with its function, namely being able to identify student misconceptions in algebraic materials and the media design is inseparable from the elements of the algebraic material itself. The results of the media expert validation assessment are as follows:

Table 4. Media Expert Value Recapitulation

No.	Media Expert Validation	Recapitulation Value	Coversion Value
1	Stage 1	62,5%	B
2	Stage 2	80%	B
Average		71,25%	B
Category		Worthy	Worthy

2) One-to-one

In the one-to-one stage carried out on May 21, 2023 along with the validation of material experts and media experts, the one-to-one stage involved three students with high, medium and low abilities from class VIII-B. Students were given a questionnaire sheet to assess and provide comments and suggestions related to the appearance aspect, material presentation aspect and benefit aspect of prototype 1 being developed.

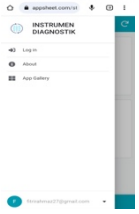
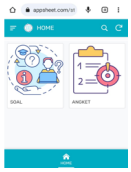
The results of the assessment of the responses of 3 students who had answered the student response questionnaire at the one-to-one stage stated that an average value of 77.9% was obtained with the agree category. Furthermore, an interview process was carried out with students about comments or suggestions related to the diagnostic instrument media used to be used as revision material for prototype 1. This revision is a combination of revisions from expert reviews and revisions from the one-to-one stage test.

Revision Prototype 1

Based on comments and suggestions from the validation of material experts and media experts at the expert review stage and student responses at the one-to-one stage. After the researcher revised prototype 1, it produced prototype 2.

Table 5. Revision *Prototype* 1 *Appsheet*

Before Revision	After Revision
The answer at level 2 in each question is only up to option 'd'	The answers at level 2 in each question are provided up to option ‘e’ which is an open answer to give students the opportunity to express their opinions.
The answer at level 2 in question number 7 concerns the definition	The answer at level 2 in question number 7 concerns the problem solving process.
Answer at level 2 part ‘d’ in question number 10	*The answer to level 2 part ‘d’ in question number 10 is*
“Repeated multiplication is adjusted to the exponent and then multiplied according to the rules of algebraic multiplication”	*"Repeated multiplication as many times as the exponent and then multiplied according to the rules of algebraic multiplication"*
The writing of the answers to algebra in questions 2 and 7 does not comply with the rules because it is intended to deceive students.	Writing the answers to algebra in questions 2 and 7 must still be in accordance with the rules. 3y + 2 x + 7
The application title is still not interesting	The application title becomes more

enough	attractive
	
There is no log-in menu	There is a log-in menu
	
There are no instructions and too few application menus.	Added guide menu and about the application
	
There is no image design on the display in each menu.	There is a picture design on the display in each menu
	
There is no menu for instructions on how to do it.	There is a menu of instructions for how to do it
	

c. Small Group

The small group stage was carried out on May 22, 2023. After the researcher revised prototype 1 and produced prototype 2, prototype 2 was then given to six high, medium and low-ability students of SMP Negeri 1 Margaasih who had studied algebra material to see the practicality of the developed diagnostic instrument. Students were given a questionnaire sheet to assess and provide comments and suggestions related to the appearance aspect, material presentation aspect and benefit aspect of the developed prototype 2. At this stage, students opened their media on their respective devices.

Based on the results of the questionnaire containing 13 statements answered by 6 students at the small group stage, an average score of 78.4% was obtained with the agree category. Furthermore, an interview process was carried out with students about comments or suggestions related to the diagnostic instrument media used as material for revision in prototype 2. Prototype 2 will be revised again so that the results become prototype 3 which is ready to be tested more widely on students.

Prototype 2 revision which was developed based on comments and suggestions from student responses at the small group stage. After the researcher made revisions to prototype 2, prototype 3 was produced. The results of the revision of prototype 2 were only developed from the writing of the contents of the media being developed.

Table 6. Revision Prototype 2 Appsheet

Before Revision	After Revision
The answer at level 2 for each question is only up to option 'd'	The answers at level 2 in each question are provided up to option ‘e’ which is an open answer to give students the opportunity to express their opinions.
The answer at level 2 in question number 7 concerns the definition	The answer at level 2 in question number 7 concerns the problem solving process.

Revision at this stage is related to the content of the media to be used, namely in the form of three-tier questions that use open reasoning. Prototype 2 will produce prototype 3 which will be continued to the field test stage with 33 students..

d. Field Test

Based on the results of the questionnaire containing 13 statements answered by 33 students at the field test stage, it was stated that the average score was 75.2% with the agree category.

Table 7. Student Response Assessment Recapitulation Phase *One to one, Small Group* and *Field Test*

No.	*One to one*		*Small Group*		*Field Test*	
	Value Index	**Criteria**	**Value Index**	**Criteria**	**Value Index**	**Criteria**
1.	79.3%	Agree	73,3%	Agree	83.3%	Strongly agree
2.	76.3%	Agree	66,6%	Agree	80%	Strongly agree
3.	78.1%	Agree	86,6%	Strongly agree	83.3%	Strongly agree
4.	80%	Strongly agree	80%	Strongly agree	83.3%	Strongly agree
5.	79.3%	Agree	86,6%	Strongly agree	86.6%	Strongly agree
6.	73.3%	Agree	73,3%	Agree	76.6%	Strongly agree
7.	80.6%	Strongly agree	80%	Strongly agree	76.6%	Agree
8.	78.7%	Agree	80%	Strongly agree	80%	Strongly agree
9.	43.6%	Disagree	60%	Agree	53.3%	Disagree
10.	77.5%	Agree	86,6%	Strongly agree	76.6%	Agree
11.	76.9%	Agree	86,6%	Strongly agree	76.6%	Agree
12.	75.1%	Agree	73,3%	Agree	83.3%	Strongly agree
13.	78.7%	Agree	80%	Strongly agree	80%	Strongly agree

The effectiveness of the instrument is carried out using descriptive statistics. Descriptive statistics aim to describe the characteristics of the data with the help of Microsoft Excel, the data of which is taken from the field test stage because the students have studied algebra material. The results of the effectiveness test are presented in the table below in the form of the results of identifying misconceptions in algebra material:

Table 8. Effectiveness Results assisted by Microsoft Excel

Understand the Concept	**Misconception**			**Don't Understand the Concept**
	Positive	**Negative**	**General**	
3,9%	8,2%	8,4%	22,1%	57,3%

The results or values obtained from the effectiveness test assisted by Microsoft Excel showed that students were identified as understanding the concept by 3.9%, positive misconceptions 8.2%, negative misconceptions 8.4%, misconceptions 22.1% and those who did not understand the concept by 57.3%. If the positive, negative and general misconceptions are added up, the total misconceptions as a whole are 38.7%. The following is a diagram of the percentage of the results of identifying misconceptions:

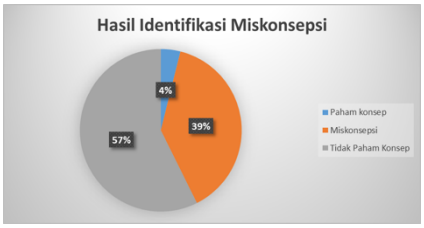


Figure 5. Misconception Identification Results

Based on the image of the results of the misconception identification, it is clear that the level of understanding of class VIII students at SMP Negeri 1 Margaasih on algebra material is still very low. This concludes that the three-tier diagnostic test instrument assisted by the appsheet can provide a potential effect to identify misconceptions of junior high school students' algebra material.

The implementation of the research during the development of the three-tier diagnostic test instrument assisted by the appsheet to identify misconceptions of algebra material, the researcher also noted the obstacles found by the researcher during the product development process at each stage, namely as follows:

Table 9. Constraints to Instrument Development

Research Stages		**Constraint**
Preliminary Design	Preparation	The difficulty in determining the research schedule is because teachers do not want their teaching and learning schedules to be disrupted, so the research is carried out after class hours are finished.
	Development	Researchers have difficulty in determining the initial idea for designing the instrument to be developed. Lack of ability of researchers to create instrument designs using the appsheet application
Formative Evaluation	Self-evaluation	The preparation of the instrument took quite a long time
	Prototyping (expert review & one-to-one)	It is difficult to find expert review because many other researchers also request instrument validation, thus making the validation process quite hampered. Due to the rule that students at SMP Negeri 1 Margaasih are not allowed to bring cell phones, coordination with the school is needed so that only students who are being studied are allowed to bring cell phones.
	Small Group	The application sometimes experiences errors because it is used by many users at the same time, so different codes must be created when inputting data.
	Field Test	The application sometimes errors because the student's email is problematic, so a new email is needed to be able to use the application.

Discussions

This Design-Research (DR) method development research was used by researchers in the process of developing a three-tier diagnostic test instrument assisted by an appsheet to identify misconceptions in junior high school students' algebra material. The model used in this study is Design-Research with a type of development studies with two stages, namely preliminary design and formative evaluation.(Nizar et al., 2018)

The preliminary design stage consists of two stages, namely the planning stage and the development stage. Researchers conducted a needs analysis by analyzing the 2013 curriculum for mathematics for grade VIII junior high school to identify basic competencies, learning outcomes, learning indicators and materials contained in the developed learning media. According to Murti (Yanmadika et al., 2020) the implementation of the 2013 curriculum by the government is expected to help prepare students' skills in facing 21st century developments such as critical thinking skills, creative thinking skills and communication skills.

The development stage is carried out after the planning stage is completed. This stage consists of three stages, namely the topic development stage, namely by developing basic algebra topics based on indicators and learning objectives achieved, the drafting stage by determining the sequence of topics and components written or designed into a prototype of learning media including competencies consisting of core competencies, basic competencies and indicators to identify student misconceptions in algebra material. There is a menu in the form of a guide, about, questions and questionnaires. and the prototype production stage, the researcher designs the results of the background design, elements or icons, buttons according to algebra material, neat and colored text, tables that are arranged and adjusted to the text so that the appearance of each page is neatly and attractively arranged.

According to Tessmer (Purwitaningrum & Prahmana, 2021) the formative evaluation stage consists of self-evaluation, expert review and one-to-one, small group and field test stages. At the self-evaluation stage, researchers with the help of supervisors assess and re-examine prototype 1 of the developed learning media. After improving the self-evaluation, the researchers then move on to the expert review stage. Prototype 1 of this learning media in the form of a diagnostic instrument was validated by two lecturers and one teacher as material experts and one media expert lecturer. There are several things that need to be revised, namely the initial display adding a log in button (ID and Password), adding an image design to the log in feature, and adding a menu of instructions for working on and attendance. This diagnostic instrument media was revised according to suggestions from experts so that its use is attractive and in accordance with its function, namely being able to identify student misconceptions in algebra material and the media design is inseparable from the elements of the algebra material itself.

The one-to-one stage was conducted with three students of SMP Negeri 1 Margaasih who had taken the mathematics subject of algebra material. This stage aims to test the practicality of prototype 1 that has been made by the researcher from the user's perspective by filling out the student response questionnaire sheet regarding the use of prototype 1. The results of the assessment of the responses of three students who had answered the student response questionnaire at the one-to-one stage stated that on average students answered in the agree category. Comments and suggestions from the one-to-one results were then used to improve prototype 1 so that prototype 2 was produced.

The results of the prototype 1 revision are that the answers at level 2 in each question are provided up to option 'e' which is an open answer to give students the opportunity to express their opinions, the answer at level 2 in question number 7 is about the process of solving the

question, the answer at level 2 part 'd' in question number 10 becomes "Repeated multiplication as many times as the exponent then multiplied according to the rules of algebraic multiplication", writing the answers from algebra in questions number 2 and 7 must still be in accordance with the rules, the application title becomes more attractive, there is a log-in menu, adding a guide menu and about the application, there is a picture design on the display in each menu and there is a menu of instructions for working on it.

After the researcher revised prototype 1 and produced prototype 2, then at the small group stage, prototype 2 was given to six students of SMP Negeri 1 Margaasih who had studied algebra material to see the practicality of the learning media developed. Based on the results of the questionnaire answered by six students at the small group stage, it was stated that the average student answered in the agree category. Comments and suggestions from the small group results were then used to improve prototype 2 so that prototype 3 was produced.

The results of the prototype 2 revision are that the answers at level 2 in each question are provided up to option 'e' which is an open answer in order to provide students with the opportunity to express their opinions and the answers at level 2 in question number 7 are regarding the process of solving the question.

After the small group stage is carried out, the next stage is the field test stage. After obtaining prototype 3, the instrument is tested at the field test stage to see the potential effects on student responses. According to Anisah et al. (2011) that products that have been tested at the field test stage must have met the quality criteria. There are three quality criteria, namely validity (from experts, colleagues and mathematics teachers), practicality (easy to use and can be used in the learning process), and questions have potential effects seen from the results of students' mathematical reasoning ability tests (Van Den Akker, 1999).

CONCLUSION

This study concluded that the development of a three-tier diagnostic test instrument assisted by Appsheet to identify junior high school students misconceptions in algebra was successfully carried out using a design research method with two stages, namely the preliminary design and formative evaluation. The expert review results categorized the developed instrument as feasible for use, indicating that it met the standards of validity and practicality as a diagnostic tool. Moreover, the instrument proved effective in identifying students misconceptions in algebra, showing that the integration of Appsheet can enhance the accuracy and accessibility of diagnostic assessments in mathematics learning.

Despite its success, several challenges were encountered, including limited technical skills in designing with Appsheet, lengthy instrument preparation, and insufficient school facilities for mobile-based implementation. Occasional technical errors also occurred when the application was accessed by many users simultaneously. Therefore, future studies are recommended to further improve and expand the use of digital diagnostic tools in mathematics education. Teachers and schools should be encouraged to adopt similar technology-based instruments and provide adequate infrastructure and training support. Continuous updates and refinements of digital platforms like Appsheet are essential to ensure stability, accessibility, and sustainability in classroom practice.

REFERENCES

Abidin, Z. (2019). Analisis Miskonsepsi Materi Aljabar pada Siswa Kelas VII SMP Negeri 17 Makassar dengan Menggunakan Three Tier Test. In *Alauddin Journal of Mathematics Education*. https://repositori.uin-alauddin.ac.id/16399/1/Zainal Abidin.pdf

Afifaturrohmaniyyah, N., & Malasari, P. N. (2021). Problematika guru dalam mengajar

materi aljabar di era pandemik Coronavirus Disease 2019 (Covid-19). *Jurnal Pendidikan Matematika (Kudus)*, *4*(1), 43. https://doi.org/10.21043/jmtk.v4i1.10083

Anisah, Zulkardi, & Darmawijoyo. (2011). Pengembangan soal matematika model pisa pada konten quantity untuk mengukur. *Jurnal Pendidikan Matematika*, *5*(1), 14–26. https://ejournal.unsri.ac.id/index.php/jpm/article/download/333/99

Artiawati, P. R., Muliyani, R., & Kurniawan, Y. (2016). Identifikasi kuantitas siswa yang miskonsepsi menggunakan three tier-test pada materi Gerak Lurus Berubah Beraturan (GLBB). *JIPF (Jurnal Ilmu Pendidikan Fisika)*, *1*(1), 13–15. https://doi.org/10.26737/jipf.v3i1.331

Azis, A. (2019). Analisis Kesulitan Siswa dalam Menyelesaikan Soal Cerita pada Pembelajaran Matematika Kelas VIII. *Jurnal Akademik Pendidikan Matematika*, *5*(1), 64–72. https://doi.org/10.31219/osf.io/7fpjz

Fabilla, W., Wijayanti, A., & Cahyadi, F. (2023). Analisis Miskonsepsi Siswa Kelas IV pada Pembelajaran IPA melalui Metode Three Tier Test di SD Negeri Wonowoso 1 Demak. *Judika (Jurnal Pendidikan Unsika)*, *11*(2), 129–142. https://doi.org/10.35706/judika.v11i2.8725

Hasibuan, I. (2015). Hasil belajar siswa pada materi bentuk aljabar di kelas VII SMP Negeri 1 Banda Aceh tahun pelajaran 2013/2014. *Jurnal Peluang*, *4*(1), 5–11. https://jurnal.usk.ac.id/peluang/article/view/5853/4845

Hoiriyah, D. (2019). Analisis kemampuan pemahaman konsep matematis mahasiswa. *Logaritma : Jurnal Ilmu-Ilmu Pendidikan Dan Sains*, *7*(1), 123–136. https://doi.org/10.24952/logaritma.v8i02.2773

Hutami, A., Azizah, N. A., & Norlita. (2023). Kecanggihan smartphone sebagai media pembelajaran di era modern. *Borneo Journal of Islamic Education*, *3*(1), 65–73. http://journal.uinjkt.ac.id/index.php/edusains

Karolin T, N., Sulandra, I. M., & Subanji. (2016). Miskonsepsi pada penyelesaian soal aljabar siswa kelas VIII berdasarkan proses berpikir Mason. *Jurnal Pendidikan : Teori, Penelitian, Dan Pengembangan*, *1*(10), 1917–1925. http://journal.um.ac.id/index.php/jptpp/article/view/6942/3067

Kusumawardani, D. R., Wardono, & Kartono. (2018). Pentingnya penalaran matematika dalam meningkatkan kemampuan literasi matematika. *PRISMA, Prosiding Seminar Nasional Matematika*, *1*(1), 588–595. https://journal.unnes.ac.id/sju/index.php/prisma/article/view/20201

Mardiyah, A., Mayasari, T., & Huriawati, F. (2020). Pengembangan Rotational Dynamics Conceptual Survey (RDCS). *EDUSAINS*, *12*(2), 177–187. http://journal.uinjkt.ac.id/index.php/edusains

Nizar, H., Putri, R. I. I., & Zulkardi. (2018). Developing pisa-like mathematics problem using the 2018 Asian Games football and table tennis context. *Journal on Mathematics Education*, *9*(2), 183–194. https://doi.org/10.22342/jme.9.2.5246.183-194

Novitasari, D., Tangerang, U. M., Pemahaman, K., & Matematis, K. (2016). Pengaruh penggunaan multimedia interaktif terhadap kemampuan pemahaman konsep matematis siswa. *FIBONACCI, Jurnal Pendidikan Matematka Dan Matematika*, *2*(2), 8–18. https://doi.org/10.24853/fbc.2.2.8-18

Purnomo, E., Rhomadhoni, I., & Widad, N. R. (2022). Implementasi QRcode pada presensi kehadiran menggunakan platform. *Jurnal Kecerdasan Buatan, Komputasi Dan*

Teknologi Informasi, *3*(1), 54–61.

Purwitaningrum, R., & Prahmana, R. C. I. (2021). Developing Instructional Materials on Mathematics Logical Thinking through the Indonesian Realistic Mathematics Education Approach. *International Journal of Education and Learning*, *3*(1), 13–19. https://doi.org/10.31763/ijele.v3i1.178

Putrawangsa, S. (2019). *Design research sebagai framework desain pembelajaran*. http://repository.uinmataram.ac.id/id/eprint/2995

Rahmawati, M., Husen, M., & Nurbaity. (2018). Analisis kerjasama guru Bimbingan Konseling (BK) dengan guru bidang studi dalam mengatasi kesulitan belajar pada siswa di SMP Kota Banda Aceh. *Jurnal Ilmiah Mahasiswa Bimbingan Dan Konseling*, *3*(3), 38–42. https://jim.usk.ac.id/pbk/article/view/4971

Rizki Nurhana Friantini, Rahmat Winata, Pradipta Annurwanda, Siti Suprihatiningsih, Muhammad Firman Annur, Bernadeta Ritawati, & Iren. (2020). Penguatan konsep matematika dasar pada anak usia sekolah dasar. *Jurnal Abdimas Bina Bangsa*, *1*(2), 276–285. https://doi.org/10.46306/jabb.v1i2.55

Siregar, N. R. (2017). Persepsi siswa pada pelajaran matematika: studi pendahuluan pada siswa yang menyenangi game. *Prosiding Temu Ilmiah X Ikatan Psikologi Perkembangan Indonesia*, *1*(1), 224–232. https://jurnal.unissula.ac.id/index.php/ippi/article/view/2193

Sugiarti, F., & Sukarmin. (2019). Mendeteksi dan mereduksi miskonsepsi dengan menggunakan software dered misequilibri pada materi kesetimbangan kimia. *Unesa Journal of Chemical Education*, *8*(1), 94–100. https://ejournal.unesa.ac.id/index.php/journal-of-chemical-education/article/view/27037/24745

Van Den Akker, J. (1999). Principles and methods of development research. In *Design Approaches and Tools in Education and Training*. https://doi.org/10.1007/978-94-011-4255-7_1

Yanmadika, A. A. I., Izzati, N., & Rezky, R. (2020). Pengembangan lembar kerja peserta didik dengan pendekatan STEM pada materi bangun ruang sisi datar. *Student Online Journal*, *1*(2), 555–562. https://soj.umrah.ac.id/index.php/SOJFKIP/article/download/533/461