

# CANVA-ASSISTED DISCOVERY LEARNING WORKSHEETS TO IMPROVE STUDENTS' MATHEMATICAL COMMUNICATION AND SELF-CONFIDENCE ON VOCATIONAL HIGH SCHOOL

Agustin Mulyantini<sup>1</sup>, Jozua Sabandar<sup>2</sup>, Anik Yuliani<sup>3</sup>

<sup>1</sup>IKIP Siliwangi, Jl. Terusan Jend. Sudirman, Cimahi, Indonesia.

[agustinmulyantini1989@gmail.com](mailto:agustinmulyantini1989@gmail.com)

<sup>2</sup>IKIP Siliwangi, Jl. Terusan Jend. Sudirman, Cimahi, Indonesia.

[jsabandar@yahoo.com](mailto:jsabandar@yahoo.com)

<sup>3</sup>IKIP Siliwangi, Jl. Terusan Jend. Sudirman, Cimahi, Indonesia.

[anikyuliani0407088601@ikipsiliwangi.ac.id](mailto:anikyuliani0407088601@ikipsiliwangi.ac.id)

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## ABSTRACT

The generally low levels of students' mathematical communication skills and self-confidence, particularly in arithmetic sequences and series, formed the primary basis for this study. Therefore, the effectiveness of a mathematics student worksheet based on the discovery learning model needs to be examined. The Canva application is considered a promising tool for improving vocational high school students' mathematical communication skills and self-confidence. This study was conducted using the Research and Development (R&D) method by following the development stages proposed by Borg and Gall. The participants were Grade X vocational high school students at a private school in Karawang. The instruments included validation sheets, teacher and student response questionnaires using a Likert scale, a mathematical communication skills test, and a self-confidence scale. The results showed that the developed student worksheet was rated as highly valid by content and media experts and met the criteria for being highly practical based on teacher and student responses. In addition, this mathematics student worksheet, based on the discovery learning model and supported by the Canva application, was effective, as indicated by higher N-gain scores, greater mastery in the experimental class than in the control class, and a significant increase in students' self-confidence scores. Statistical tests confirmed that the use of this mathematics student worksheet significantly improved students' mathematical communication skills and self-confidence compared with conventional instruction. The mathematics student worksheet, based on the discovery learning model and assisted by the Canva application, is feasible and effective as an innovative solution for vocational high school learning.

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### Corresponding Author:

Agustin Mulyantini,  
Department of Mathematics Education,  
Institut Keguruan dan Ilmu Pendidikan Siliwangi,  
Jl. Terusan Jend. Sudirman, Cimahi, Indonesia  
Email: [agustinmulyantini1989@gmail.com](mailto:agustinmulyantini1989@gmail.com)

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## INTRODUCTION

Mathematical communication is the ability to use mathematical language clearly to explain mathematical expressions through appropriate, logical arguments. Therefore, mathematical communication is essential in the mathematics learning process to achieve the intended learning objectives (Rangkuti & Firdaus, 2024). Mathematical communication skills refer to students' ability to convey what they know, including concepts, formulas, and problem-solving strategies (Noviyana et al., 2019). Since the objective of mathematics learning is not merely to master the subject matter, students need strong mathematical communication skills to determine appropriate solutions to everyday mathematical problems. Mathematical communication skills need to be developed in mathematics learning, as communication enables students to organize their mathematical thinking, both orally and in writing.

Several studies have shown that students' mathematical communication skills remain low. Rangkuti and Firdaus (2024) reported that students' mathematical communication skills were at a very low level, with a score of 59.7%. Research findings (Wijayanto et al., 2018) indicate that test results regarding mathematical communication skills, specifically concerning the topics of triangles and quadrilaterals were below average, revealing that students' mathematical communication proficiency remains low. This is also consistent with the findings of research conducted by Zaditania et al. (2022), which indicate that the mathematical communication skills of junior high school students remain low. In addition to mathematical communication skills, self-confidence is another essential attribute that students should possess. Strong self-confidence can motivate students to improve their mathematical abilities and achievement (Noviyana et al., 2019).

Self-confidence is a belief in one's own abilities and confidence in every decision or action taken (Hapsoh & Sofyan, 2022). Putting this belief into practice requires supporting skills and actions, with self-confidence as a key component. Valerina and Abadi (2023) reported that, based on the overall average percentage of students' responses, students demonstrated low self-confidence in mathematics learning because most did not meet the self-confidence indicators, with an average score of 64.88%. Therefore, an interactive and engaging learning model is needed to improve students' mathematical communication skills and self-confidence. Developing an effective learning model is expected to facilitate students' understanding of the material, enabling them to actively and independently comprehend concepts. One model that can be developed is the discovery learning model. The discovery learning model, adapted from Bruner's learning theory, provides students with opportunities to construct their own knowledge actively. The discovery learning model encourages students to discover mathematical concepts actively (Sahrul et al., 2020). This model can foster students' self-confidence to participate actively and develop their communication skills while independently discovering learning concepts (Kurniawan Giawa et al., 2021).

The discovery learning model focuses on a student-centered learning process. In this model, the teacher facilitates students by providing questions, directions for reading books or texts, and learning activities that lead to discovery. Several aspects of discovery learning that can improve mathematical communication include engaging teachers and students in asking and answering questions. Thus, this model can create an effective learning environment and help students develop self-confidence. To make the learning model more effective, ICT-based learning media are needed. Technological developments have changed how people think, communicate, and learn. Technology offers various benefits, particularly in supporting learning at school. The use of learning media is expected to increase students' interest in exploration and discovery activities. One ICT-based learning medium that can support the discovery learning model is the Canva application.

Canva is design software that is relatively easy to operate for both novice and professional users (Wahyuni et al., 2024). In addition, Canva is a graphic design tool recognized for its potential to improve students' visual communication. The use of the Canva application provides a way for students to participate more actively in learning (Rangkuti & Firdaus, 2024). Canva offers text, animation, and design features for creating posters, greeting cards, brochures, infographics, and presentations (Nachsyahbandi et al., 2022).

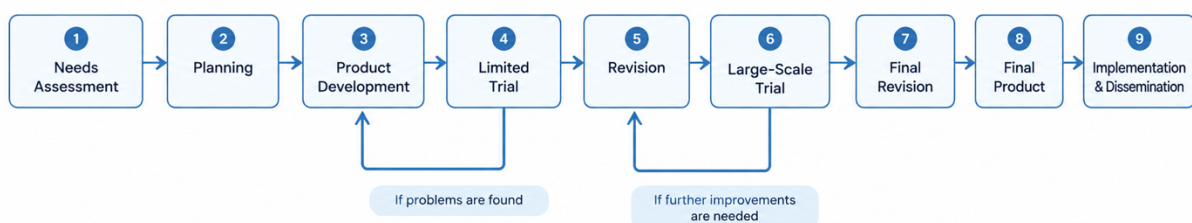
As a graphic design tool, Canva enables educators and students to easily create engaging visual content. With its intuitive design features, Canva stimulates students' creativity and facilitates the development of interactive learning materials, allowing them to create more distinctive presentations tailored to their needs. This learning model, with Information and Communication Technology such assisted by the Canva application, can improve students' mathematical communication skills and increase their confidence in expressing ideas through presentations during the learning process.

This application can improve students' learning outcomes, strengthen their self-confidence, and help them understand the material more effectively. Therefore, developing instructional materials based on the discovery learning model and using the Canva application is expected to facilitate students' understanding of the lessons, enabling them to actively and independently comprehend concepts. Therefore, there is an urgent need to design mathematics student worksheets that integrate Canva into the phases of the discovery learning model to facilitate students' mathematical communication skills and their confidence in answering the assigned problems.

Consequently, this study aims to examine how the development mathematics student worksheets based on the discovery learning model and supported by the Canva application can serve as an effective tool to enhance the mathematical communication skills and self-confidence of vocational high school (SMK) students. The novelty of this research lies in its instructional framework, specifically designed to integrate Canva features into every phase of discovery learning from stimulus presentation to drawing conclusions, thereby enabling students to communicate ideas mathematically while simultaneously boosting their confidence in learning mathematics.

## METHOD

The method used to develop a product in this study was Research and Development (R&D). The development design employed was the Borg and Gall model. This design was selected because it follows the development stages proposed by Borg and Gall for product development. The stages involved in this research are shown in the following diagram:



**Figure 1.** RnD Flowchart

The stages were conducted as follows:

1. Needs Assessment/Preliminary Study

This stage involved a systematic process to determine the objectives and identify discrepancies between the actual conditions and the expected conditions (Pramesti & Matematika, 2023). At this stage, the researcher selected the research site and arranged the

research schedule with a Grade X homeroom teacher at SMKS Indonesia Mas, the research location. The researcher conducted a needs analysis, reviewed the literature, and identified the factors causing the problems, indicating the need to develop a new product. A survey was conducted to examine these conditions as part of the needs analysis.

At this stage, the researcher conducted observations through interviews with teachers and students to identify students' potential and the problems arising during the learning process. After the observations were completed, the data were used to develop the study's teaching materials.

## 2. Planning

After conducting the preliminary study, the researcher proceeded to the second step, namely research planning. At this stage, the researcher began to establish the design of the product developed to address the problems identified through the survey. The researcher prepared teaching materials in the form of a student worksheet, an interactive learning medium based on the discovery learning model, using the Canva application. At this stage, the researcher began to determine the design of the product to be developed.

This step involved preparing a research plan, including formulating the competencies and skills related to the identified problems, determining the objectives to be achieved at each stage, designing the research procedures, and, where possible or necessary, conducting a limited feasibility study.

## 3. Product Development

The researcher developed the product through the following steps:

- a. The researcher reviewed the draft of the material to be developed.
- b. The researcher prepared a questionnaire covering the aspects that the developed product was required to meet.
- c. The researcher validated the product to obtain feedback from experts.

At this stage, the product was validated to obtain feedback from experts on the developed product (expert review). The expert review of the student worksheet was conducted by three subject-matter experts and one media expert who were qualified in the relevant subject areas. The assessments from the three subject-matter validators and one media validator provided evidence of the product's validity and practicality in terms of content and media. Based on these assessments, a valid student worksheet based on the discovery learning model and assisted by the Canva application was developed for Grade X vocational high school students on the topics of arithmetic sequences and series.

## 4. Limited Trial

After expert validation and product revision, the product was initially tested with a small group of 10 students to gather their responses.

## 5. Initial Revision

At this stage, the researcher revised the product based on the results of the limited trial.

## 6. Large-Scale Trial

The large-scale trial was conducted with a larger group of 30 students to obtain their responses to the product revised based on the previous trial.

## 7. Final Revision and Product Trial

At this stage, the researcher revised the product based on the results of the large-scale trial to improve its effectiveness and efficiency. Then, the researcher implemented the developed product, which had been revised and finalized based on the results of the previous trials.

8. Final Product

The final refinement step is based on the results of the operational field test. These final adjustments aim to ensure that the final product is valid, reliable, and ready for mass use.

9. Implementation and Dissemination

The final stage involves reporting research findings, disseminating the product through scientific publications, promoting it, or implementing it with relevant users or institutions, thereby ensuring that the development outcomes make a tangible contribution to society.

The data analysis techniques used in this study included descriptive and inferential statistics, as follows:

- Validity Data Analysis, The data from the validation sheets were analyzed using a five-point Likert scale. The obtained data were then processed to determine the percentage of product feasibility.
- Practicality Data Analysis, to determine the ease of use and usefulness of the developed student worksheet. The data were obtained from student response questionnaires completed after the learning process and were then categorized according to the established practicality criteria. The response questionnaire data were analyzed using a five-point Likert scale.
- Effectiveness Data Analysis, to evaluate the extent to which the use of a student worksheet based on the discovery learning model, assisted by Canva, positively affected students' mathematical communication skills and self-confidence. Effectiveness was assessed from two aspects: (1) the cognitive aspect, through N-gain analysis of the mathematical communication skills test scores; and (2) the affective aspect, through analysis of the mean scores on the students' self-confidence scale. The instructional materials were considered effective when the improvements in students' mathematical communication skills and self-confidence were statistically significant, and the N-gain score met the established criteria. The effectiveness of the student worksheet in improving mathematical communication skills was measured using the pretest and posttest results. The data were analyzed using the N-gain test to determine the level of improvement in students' skills and were then categorized based on the gain score achieved.

## RESULTS AND DISCUSSION

### *Results*

#### *Preliminary Study and Information Gathering*

At this stage, the researcher selected a private vocational high school in Karawang as the research site and met with a Grade X homeroom teacher to collect relevant information. Interviews with teachers and students revealed that the teaching materials were still conventional and that students had difficulty with several topics, including arithmetic sequences and series. Therefore, a new product needed to be developed to improve vocational high school students' mathematical communication skills and self-confidence.

#### *Planning*

Based on the needs analysis conducted after the preliminary study, the researcher developed a mathematics student worksheet using the discovery learning model, assisted by the Canva application, to improve vocational high school students' mathematical communication skills and self-confidence. This stage included determining and preparing drafts of the assessment instruments, including validation sheets, practicality questionnaires, a mathematical communication skills test blueprint, and a self-confidence scale, as well as designing the worksheet flow to align with the six stages of the discovery learning syntax.

### Product Development

The researcher developed a mathematics student worksheet based on the discovery learning model, assisted by the Canva application, and prepared a questionnaire to validate the product. After the product was designed, the student worksheet based on the discovery learning model was validated. The validation was conducted by three subject-matter experts and one media expert, all qualified in the relevant subject areas.

At this stage, the researcher revised the student worksheet based on expert feedback to produce a draft ready for trial. Several components were revised after the expert validation process, including the wording in the data-processing stage of the student worksheet. The wording in this stage was revised to guide students in discovering the concepts underlying the problems presented. Before being tested with students, the developed product was first validated by material and media experts to assess the feasibility of the learning model.

**Table 1.** Product Validation Results

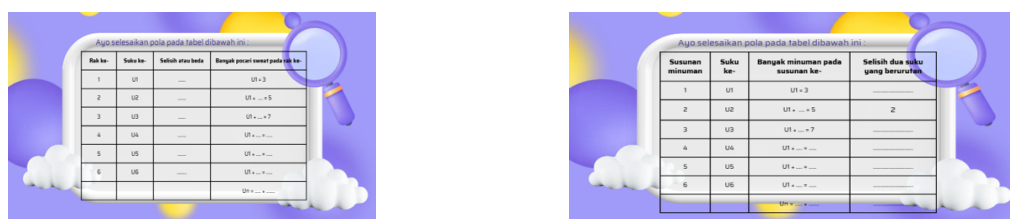
| Rated aspect                | V1        | V2        | V3        | Total Score | SMI        | Percentage    | Criteria          |
|-----------------------------|-----------|-----------|-----------|-------------|------------|---------------|-------------------|
| Completeness of Content     | 38        | 42        | 36        | 116         | 135        | 85,93%        | Very Valid        |
| Linguistics Appropriateness | 13        | 12        | 12        | 37          | 45         | 82,22%        | Very Valid        |
| Presentation of worksheets  | 17        | 14        | 18        | 49          | 60         | 81,67%        | Very Valid        |
| ICT used                    | 12        | 12        | 12        | 36          | 45         | 80,00%        | Very Valid        |
| <b>Total</b>                | <b>48</b> | <b>48</b> | <b>52</b> | <b>148</b>  | <b>168</b> | <b>82,45%</b> | <b>Very Valid</b> |

Table 1 shows that the mean total assessment score given by the subject-matter validators for the developed student worksheet was 82,45%. Based on the validity criteria, the overall assessment of the student worksheet met the criterion of “very valid and usable”.

**Table 2.** Media Validation Results

| Rated aspect                     | V1        | Total Score | SMI       | Percentage    | Criteria          |
|----------------------------------|-----------|-------------|-----------|---------------|-------------------|
| Quality and Completeness         | 39        | 39          | 45        | 86,67%        | Very Valid        |
| Effective and Efficient Learning | 13        | 13          | 15        | 86,67%        | Very Valid        |
| Appearance                       | 16        | 16          | 20        | 80,00%        | Very Valid        |
| ICT used                         | 13        | 13          | 15        | 86,67%        | Very Valid        |
| <b>Total</b>                     | <b>48</b> | <b>81</b>   | <b>95</b> | <b>85,00%</b> | <b>Very Valid</b> |

Table 2 shows that the total assessment score from the media validator for the student worksheet, assisted by the Canva application, was 85.00%. Based on the assessment criteria, the student worksheet met the very valid and usable criteria. The revisions made to the student worksheet are presented in the following table:



**Figure 2.** Worksheets Before (Left) and After (Right) Revision

### *Limited Trial Stage*

The limited trial was conducted with 10 students at a private vocational high school in Karawang. This trial aimed to assess students' comprehension of the mathematics student worksheet based on the discovery learning model and assisted by the Canva application developed by the researcher. One technique used to collect data during the trial was a questionnaire administered to evaluate the practicality of the developed student worksheet. The results are presented in the following table.

**Table 3.** Limited Trial Results

| Rated aspect             | Total Score | SMI         | Percentage    | Criteria              |
|--------------------------|-------------|-------------|---------------|-----------------------|
| Appearance               | 217         | 250         | 86,80%        | Very Practical        |
| Easy of Use              | 204         | 250         | 81,60%        | Very Practical        |
| Presentation of Material | 241         | 300         | 80,33%        | Practical             |
| Advantage                | 216         | 250         | 86,40%        | Very Practical        |
| <b>Total</b>             | <b>878</b>  | <b>1050</b> | <b>83,78%</b> | <b>Very Practical</b> |

Table 3 shows a mean percentage of 83,78%, indicating that, according to the students, the practicality of the student worksheet based on the discovery learning model and assisted by the Canva application was classified as Very Practical.

### *Initial Revision Stage*

At this stage, the researcher revised the product based on the results of the limited trial. Several visual components were revised, including the introductory page for the stimulation stage in the student worksheet, based on the discovery learning model and assisted by the Canva application. The page was modified to place greater emphasis on initial stimulation to support a better understanding of arithmetic sequences and series.

The student worksheet, based on the discovery learning model and assisted by the Canva application, revised based on the initial revision stage, is presented in the following figure:



**Figure 3.** Worksheet Before (Left) and After (Right) Revision

### *Large-Scale Trial Stage*

The large-scale trial was conducted with 30 students at a private vocational high school in Karawang. This trial was a continuation of the limited trial before the developed product was implemented in the experimental and control classes. The large-scale trial aimed to assess students' comprehension of the student worksheet based on the discovery learning model and assisted by the Canva application developed by the researcher. One technique used to collect

data during the trial was a questionnaire administered to reassess the practicality of the revised student worksheet. The results are presented in the following table:

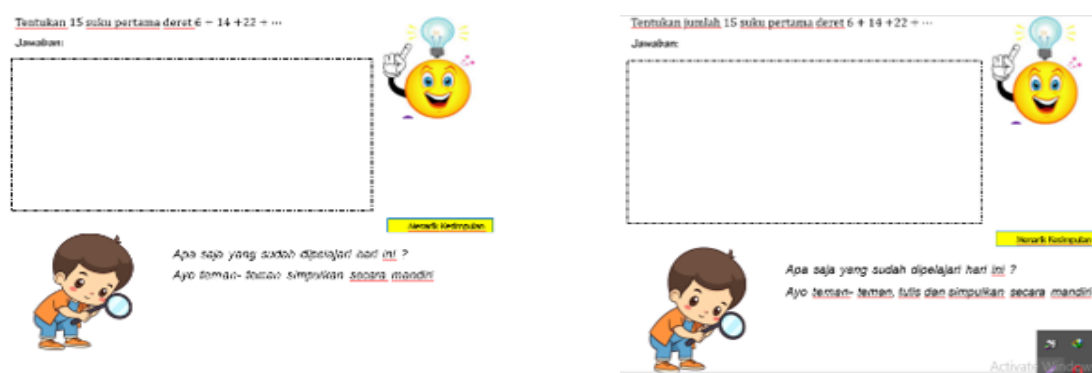
**Table 4.** Large-Scale Trial Results

| Rated aspect             | Total Score | SMI         | Percentage    | Criteria              |
|--------------------------|-------------|-------------|---------------|-----------------------|
| Appearance               | 667         | 750         | 88,93%        | Very Practical        |
| Easy of Use              | 624         | 750         | 83,20%        | Very Practical        |
| Presentation of Material | 781         | 900         | 86,78%        | Very Practical        |
| Advantage                | 640         | 750         | 85,33%        | Very Practical        |
| <b>Total</b>             | <b>2712</b> | <b>3150</b> | <b>86,06%</b> | <b>Very Practical</b> |

Table 4 shows a mean percentage of 86,06%, indicating that, according to the students, the practicality of the student worksheet based on the discovery learning model and assisted by the Canva application was classified as Very Practical.

#### *Final Revision and Product Trial*

At this stage, the researcher revised the product based on the results of the large-scale trial to improve the effectiveness and efficiency of the developed product.



**Figure 4.** Worksheet Before (Left) and After (Right) Revision

#### *Final Product*

After the large-scale trial and revisions to the student worksheet based on the discovery learning model and assisted by the Canva application, the researcher conducted the product trial. The trial was conducted at a private vocational high school in Karawang, with Grade X TKJ A as the experimental class and Grade X TKJ C as the control class. At the initial stage, the researcher administered a pretest to both classes to determine students' mathematical communication skills and self-confidence. The researcher then provided treatment to the experimental class through learning activities using teaching materials, a student worksheet, and Canva-assisted learning media on arithmetic sequences and series based on the discovery learning model. Meanwhile, the control class received conventional instruction. The study consisted of six meetings: four for the learning process and two for the pretest and posttest.

#### *Implementation and Dissemination*

The descriptive statistics in table 5 showed a significant difference in the average increase in mathematical communication skills scores between the experimental and control groups. The average post-test score for the experimental group increased by 28,66 points from 49,47 to 78,13, while the control group increased by 9,5 points from 48,23 to 57,73. This overview

provides an initial indication that the intervention using a mathematics student worksheet based on the discovery learning model and assisted by the canva is more effective in enhancing students' mathematical communication skills.

**Table 5.** Mathematical Communication Descriptive Statistics Score

|                      | N  | Minimum | Maximum | Mean  |
|----------------------|----|---------|---------|-------|
| Pre-Test Experiment  | 30 | 45      | 70      | 49,47 |
| Post-Test Experiment | 30 | 40      | 85      | 78,13 |
| Pre-Test Control     | 30 | 66      | 50      | 48,23 |
| Post-Test Control    | 30 | 68      | 72      | 57,73 |

We assumed that the data are normal distributed and homogene, so we continue to do hypothetical test.

**Table 6.** Descriptive Statistics Results

| Group Statistics |                  |    |       |                |                 |
|------------------|------------------|----|-------|----------------|-----------------|
| Kelas            |                  | N  | Mean  | Std. Deviation | Std. Error Mean |
| Nilai            | Kelas Eksperimen | 30 | 78,13 | 3,170          | ,579            |
|                  | Kelas Kontrol    | 30 | 57,73 | 5,753          | 1,050           |

**Table 7.** Hypotetical Test Results

| Independent Samples Test                |                             |        |       |                              |        |                 |                 |                       |                                           |        |
|-----------------------------------------|-----------------------------|--------|-------|------------------------------|--------|-----------------|-----------------|-----------------------|-------------------------------------------|--------|
| Levene's Test for Equality of Variances |                             |        |       | t-test for Equality of Means |        |                 |                 |                       |                                           |        |
|                                         |                             | F      | Sig.  | t                            | df     | Sig. (2-tailed) | Mean Difference | Std. Error Difference | 95% Confidence Interval of the Difference |        |
| Nilai                                   | Equal variances assumed     | 13,347 | <,001 | 17,010                       | 58     | <,001           | 20,400          | 1,199                 | 17,999                                    | 22,801 |
|                                         | Equal variances not assumed |        |       | 17,010                       | 45,125 | <,001           | 20,400          | 1,199                 | 17,985                                    | 22,815 |

The posttest analysis yielded a one-tailed p-value of  $< .001$ . Because this value was less than .05,  $H_0$  was rejected, supporting  $H_1$ . The experimental class also obtained a higher mean rank than the control class, with a mean rank of 55.91 and 35.09, respectively. Therefore, students taught using the student worksheet, based on the discovery learning model and assisted by Canva, demonstrated significantly higher mathematical communication skills than those receiving conventional learning.

The N-gain analysis also yielded a one-tailed p-value of  $< .001$ . Because this value was less than .05,  $H_0$  was rejected, supporting  $H_1$ . The experimental class obtained a higher mean rank of 59.44 than the control class, which obtained 31.56. This result indicated that the improvement in mathematical communication skills among students taught using the student worksheet based on the discovery learning model and assisted by Canva was significantly greater than that among students receiving conventional learning.

The self-confidence analysis yielded a one-tailed p-value of  $< .001$ . Because this value was less than .05,  $H_0$  was rejected, supporting  $H_1$ . The experimental class obtained a higher mean rank of 59.70 than the control class, which obtained 31.30. Therefore, students taught using the student worksheet based on the discovery learning model and assisted by Canva demonstrated significantly higher self-confidence in mathematics than those receiving conventional learning.

**Table 7.** Students' Mathematical Communication Results

| Statistics         | Experimental Classes |          |        | Control Class |          |        |
|--------------------|----------------------|----------|--------|---------------|----------|--------|
|                    | Pretest              | Posttest | N-Gain | Pretest       | Posttest | N-Gain |
| Mean               | 49,47                | 78,13    | 0,56   | 48,23         | 57,73    | 0,18   |
| Percentage         | 49,47                | 78,13%   | 56%    | 48,23%        | 57,73%   | 18%    |
| Number of Students | 30                   |          |        | 30            |          |        |

Based on the data presented in Table 11, both classes began the learning process with comparable initial abilities, with mean pretest scores of 49,47 in the experimental class and 48,23 in the control class. However, after the treatment was administered, a marked difference in improvement was observed between the two groups. The experimental class, which used the Canva-assisted discovery learning-based student worksheet, achieved a mean posttest score of 78,13 (78,13%), whereas the control class achieved 57,73 (57,73%). The N-gain scores of 0,56 in the experimental class and 0,18 in the control class placed both classes in the Moderate category. Nevertheless, the experimental class showed a numerically greater improvement in mathematical communication skills than the control class.

### ***Self-Confidence Analysis***

In addition to cognitive skills, the effectiveness of the Canva-assisted discovery learning-based student worksheet was also assessed in terms of the affective aspect, namely self-confidence. Self-confidence data were obtained through questionnaires administered to students in the experimental and control classes after the learning process was complete. A summary of the students' self-confidence questionnaire results is presented in the following table:

**Table 8.** Students' Self-Confidence Comparison

| Statistics         | Experimental Classes | Control Class |
|--------------------|----------------------|---------------|
|                    | Posttest             | Posttest      |
| Mean               | 93,13                | 81,50         |
| Percentage         | 80,28%               | 70,25%        |
| Number of Students | 30                   | 30            |

Table 8 shows a marked difference in self-confidence between the two classes. The control class obtained a mean score of 81,50 (70,25%), which was classified as High. Meanwhile, the experimental class achieved a higher mean score of 93,13 (80,2%), which was classified as Very High. The 13.13% difference indicates that the student worksheet, based on the discovery learning model and assisted by Canva, was more effective at improving students' self-confidence than conventional instruction.

### ***Discussions***

Based on the limited trial results, several aspects required further revision to improve the quality of the student worksheet. One suggestion concerned the accessibility of the learning media, which should be developed in an online format. This development was intended to provide students with greater flexibility to access materials anytime, anywhere, without being limited to offline use. In response, the researcher provided an online link to the Canva presentation containing the materials for each meeting. The revisions based on the limited trial ensured that the instructional materials met the Very Valid and Very Practical criteria and were appropriate for the research participants' needs before proceeding to the large-scale trial. Consistent with

these findings, Wahyuni et al. (2024) reported that a Canva-assisted, ethnomathematics-based student worksheet on circle topics, developed to improve students' mathematical communication skills, met the very feasible criterion.

Upon completion of the large-scale trial with no significant revisions required, the instructional materials were finalized as the final product. The product was subsequently used in an experimental study at a private vocational high school in Karawang to assess its feasibility and effectiveness in improving students' mathematical communication skills and self-confidence.

After revisions based on the limited and large-scale trials, the student worksheet proceeded to the final product trial stage. The trial was conducted over six meetings, consisting of a pretest, four learning sessions, and a posttest. Through the integration of technology and the discovery learning model, students in the experimental class were encouraged to solve contextual problems actively. The comparison between the two classes served as the basis for evaluating the student worksheet's effectiveness in improving students' mathematical communication skills and self-confidence.

Based on the description above, the development of the student worksheet based on the discovery learning model and assisted by Canva followed the Borg and Gall research stages. This finding is consistent with Muslimah's (2020) study on the importance of student worksheets in the scientific approach to mathematics learning. In addition, this result is supported by Khotimah et al. (2020), who developed a Character Education Strengthening-based mathematics e-worksheet for Grade V elementary school students. Similarly, Alfiana et al. (2021) reported that a contextual student worksheet based on the ICT-assisted Preprospec model could improve students' mathematical communication skills.

The validity and practicality assessments showed that the developed Canva-assisted discovery learning-based student worksheet met the Very Valid and Very Practical criteria and was therefore considered feasible for use. This finding is consistent with Sahrul et al. (2020), who reported that mathematics instructional materials based on the discovery learning model to facilitate students' mathematical communication skills met the valid and practical criteria and were feasible for use. In addition, Juliangkary et al. (2025) showed that a discovery learning-based student worksheet developed to improve secondary school students' mathematical literacy met the Very Valid and Very Practical criteria and was highly feasible. Similarly, Wahyuni et al. (2024) reported that a Canva-assisted ethnomathematics-based student worksheet on circle topics met the Very Valid and Practical criteria and was feasible for use.

The student worksheet met the Very Valid and Very Practical criteria for several reasons. In terms of validity, the worksheet was systematically developed using the discovery learning syntax, which was aligned with curriculum requirements and students' mathematical communication skills. This finding is consistent with Effendi et al. (2021), who reported that discovery learning-based student worksheets are highly relevant to curriculum requirements because they encourage students to explore logical problem-solving strategies actively. The use of Canva also supported mathematical accuracy through dynamic concept visualization, thereby minimizing the risk of misconceptions. This finding is consistent with Joshi and Singh (2020), who emphasized that Canva allows students to view accurate graphical representations in real time, helping them clarify abstract concepts in systems of linear equations and reduce misunderstandings.

Meanwhile, practicality was supported by the visually appealing design of the student worksheet created using Canva, whose layout and typography helped students understand the instructions independently. This finding is consistent with research showing that graphic design principles in Canva, such as appropriate color contrast and typography, are important for clearly conveying information, enabling students to process information and instructions more quickly

and independently. Similarly, Romana et al. (2024) reported that visual modifications using Canva made the content and instructions in student worksheets more communicative and engaging, thereby promoting students' independence in completing classroom tasks.

Overall, the integration of a structured learning model with user-friendly technology made these instructional materials not only theoretically feasible, as evidenced by expert assessments, but also easy and efficient to implement in classroom learning. Canva was also used to design a visually engaging student worksheet to increase students' engagement and focus. This finding is consistent with Rangkuti and Firdaus (2024), who showed that implementing the discovery learning model affected students' mathematical communication skills. Accordingly, the effect of the discovery learning model on students' mathematical communication skills could be identified.

Based on the effectiveness test results, the student worksheet developed using the discovery learning model and assisted by Canva was considered effective. The effectiveness analysis showed that the improvement in students' mathematical communication skills was classified as Moderate. This result demonstrates that integrating the discovery learning model, which requires students to discover concepts independently, can support the development of their cognitive skills. This finding is supported by Widyastuti and Airlanda (2021), who confirmed that discovery learning was more effective than conventional instruction in improving elementary school students' mathematical communication skills. Similarly, Siagian et al. (2019) stated that structured support in discovery learning allows students to explore problem-solving strategies without receiving direct answers from the teacher, thereby strengthening their cognitive problem-solving skills.

Simamora et al. (2019) further reported that systematic instruction in discovery learning helps students organize complex information into logical steps for problem solving. The effectiveness of these instructional materials was further supported by the results of the one-tailed hypothesis test, which showed that the experimental class achieved a significantly greater improvement than the control class. Canva was used to provide dynamic visual representations to make the initially abstract concept of the intersection of three planes more concrete.

The use of Canva in the student worksheet played an important role in helping students visualize abstract concepts, thereby making mathematical communication more structured and easier to understand. Mukarramah et al. (2022) reported that Canva provides accurate visual representations, making concepts initially perceived as abstract more concrete and comprehensible. This finding is consistent with Wahyuni et al. (2024), who emphasized that integrating Canva into learning effectively improves mathematical communication skills by providing students with dynamic visualizations of concepts. Septian et al. (2020) further stated that the visualizations provided by Canva minimize misconceptions and facilitate students' understanding when modeling complex mathematical problems.

In addition to learning outcomes, the developed student worksheet effectively improved students' affective outcomes. This result was reflected in the experimental class students' self-confidence, which met the Very High criterion. This achievement was supported by the visually engaging design of the student worksheet created using Canva, which maintained students' focus and increased their emotional engagement throughout the learning process. Tanjung and Faiza (2019) reported that visually designed Canva-based learning media can improve students' emotional engagement and focus in mathematics learning. Similarly, Hapsari and Zulherman (2021) stated that Canva's user-friendly and aesthetically appealing design can create an engaging learning environment that directly promotes positive emotional engagement among students. Wahyuni et al. (2024) further concluded that Canva's engaging features support a more effective learning process and improve vocational high school students' self-confidence.

## CONCLUSION

Based on the research and development results, the student worksheet on arithmetic sequences and series, developed using the discovery learning model and assisted by the Canva application, met all the established quality criteria. First, the development of the student worksheet followed the Borg and Gall research stages and improved students' mathematical communication skills and self-confidence. Second, the developed student worksheet met the Very Valid and Very Practical criteria; therefore, it was feasible for use in learning, particularly in mathematics learning.

Third, the improvement in mathematical communication skills of students taught using the student worksheet based on the discovery learning model and assisted by the Canva application was greater than that of students receiving conventional instruction. This finding indicates that using the student worksheet effectively improved students' mathematical communication skills. Fourth, the self-confidence of students taught using the student worksheet was higher than that of students receiving conventional instruction. This finding indicates that using the student worksheet improved students' self-confidence. Based on these four conclusions, teachers are encouraged to implement a student worksheet aligned with the discovery learning model, assisted by the Canva application, in classroom teaching and learning activities.

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