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THE DEVELOPMENT OF STUDENT WORKSHEETS TO GROW LEARNING MOTIVATION IN ADVANCED CALCULUS SUBJECTS

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ABSTRACT
Post of the COVID-19 pandemic, online learning and self-directed learning have become commonplace, including advanced mathematics courses. Learning requires students to have a strong motivation to participate in their studies. The development of Student Worksheets (SW) is a strategy that can augment student motivation. The aim of this study was to provide a valid, practical, and effective technique for improving student motivation. This research was developmental, focusing on Student Worksheets development using the Plomp paradigm, which includes: (1) initial investigation, (2) design, (3) realization/construction, (4) testing, evaluation, and revision, and (5) implementation. The subjects of this study were 20 students registered in the Mathematics Education Program at STKIP Andi Matappa. Research instruments: (1) validation sheet for student worksheets (2) practicality sheets for student worksheets and (3) Student motivation questionnaire. The study's findings are as follows: (1) the content validity score of the SW is 0.82, classifying it as very high; (2) the practicality score of the SW is 690, signifying it fulfills very practical criteria; (3) in descriptive analysis, the average student motivation is 122.35 with a standard deviation of 18.48, categorizing it as adequate. In inferential analysis, the median student learning motivation for individuals undergoing SW therapy is classified as adequate, suggesting that the LKM treatment substantially improves student motivation. This signifies that the advanced calculus Student Worksheets developed is valid, effective, and successful in augmenting student motivation.
Keywords: advanced calculus ; student learning motivation; student worksheets

ABSTRAK
Pasca Pandemi COVID-19, penggunaan pembelajaran daring dan belajar mandiri sudah lazim digunakan, termasuk mata kuliah matematika tingkat lanjut. Pembelajaran memerlukan motivasi yang kuat dari mahasiswa untuk berpartisipasi dalam studi mereka. Pengembangan Lembar Kerja Mahasiswa (LKM) merupakan strategi yang dapat meningkatkan motivasi mahasiswa. Tujuan penelitian ini adalah untuk menyediakan teknik yang valid, praktis, dan efektif dalam meningkatkan motivasi mahasiswa. Penelitian ini bersifat pengembangan, berfokus pada pengembangan perangkat lunak menggunakan paradigma Plomp, yang meliputi: (1) penyelidikan awal, (2) desain, (3) realisasi/konstruksi, (4) pengujian, evaluasi, dan revisi, serta (5) implementasi. Subjek penelitian ini adalah mahasiswa yang terdaftar dalam Program Pendidikan Matematika di STKIP Andi Matappa sebanyak 20 orang. Instrumen penelitian: (1) Lembar Validasi LKM; (2) Lembar Praktikalitas LKM; dan (3) Kuesioner motivasi mahasiswa. Temuan penelitian ini sebagai berikut: (1) skor validitas konten LKM adalah 0,82, dikategorikan sebagai sangat tinggi; (2) skor kepraktisan LKM adalah 690, menunjukkan bahwa LKM memenuhi kriteria sangat praktis; (3) Dalam analisis deskriptif, rata-rata motivasi mahasiswa adalah 122,35 dengan simpangan baku 18,48, yang dikategorikan sebagai memadai. Dalam analisis inferensial, median motivasi belajar mahasiswa yang telah diterapkan LKM diklasifikasikan kategori memadai, menunjukkan bahwa penerapan LKM secara signifikan meningkatkan motivasi mahasiswa. Hal ini menandakan bahwa LKM kalkulus lanjut yang dikembangkan valid, efektif, dan berhasil dalam meningkatkan motivasi mahasiswa.
Kata kunci*: kalkulus lajut; motivasi belajar mahasiswa; lembar kerja mahasiswa*

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Introduction

The advanced calculus course is part of the mathematics education curriculum of STKIP Andi Matappa. This course requires completion of Calculus I and Calculus II. The advanced calculus curriculum within the mathematics education program, aligned with KKNI and National Higher Education Standards, encompasses topics from Calculus I and II, including partial derivatives, limits and continuity, differential functions of multiple variables, gradients of multivariable functions, tangent fields, multivariable chain rules, extrema of multivariable functions, as well as double and triple integrals. This subject anticipates that students who have completed this course possess independent, high-quality, and measurable performance competencies, together with a sense of responsibility for their work in their respective fields.

As stated by (Prastii et al., 2019), students engaged in independent learning must demonstrate personal initiative in their studies, complete assignments, enhance their skills, and use their learning experiences in practical settings or professional environments. Independent learning is significantly influenced by students' capacity to manage time and employ appropriate learning strategies. Consequently, students must possess self-discipline, initiative, and robust motivation to learn.

Independent learning may occur individually or collaboratively, utilizing both written and non-printed educational materials as resources. Since 2017, STKIP Andi Matappa has offered educational support services through an online learning system utilizing the Moodle Learning Management System (LMS). Independent study entails the autonomy of scheduling study time, unencumbered by spatial and geographical constraints. The Covid-19 pandemic, which precipitated a global public health disaster, significantly affected the education sector. The Ministry of Education and Culture has issued circular number 36962 / MPK.A / HK / 2020, mandating remote and online learning to mitigate the transmission of Coronavirus Disease (Covid-19). The advanced calculus curriculum has transitioned to online learning to facilitate the continuation of the educational process. This distinctly alters the learning paradigms, necessitating that educators and instructional designers deliver course content and instruct students directly via distant digital platforms. Online learning enables students to engage with instructors via many apps, including e-classrooms, video conferencing, telephone, live chat, Zoom, or WhatsApp groups. The learning activity represents an educational innovation designed to address the challenges associated with the availability of diverse learning resources.

According to (Nakayama et al., 2021), the literature suggests that not all students would excel in online learning due to variations in learning environment elements and individual student characteristics. A key factor in successful learning is student motivation (Berestova et al., 2022). (Luo et al., 2021; Shin, 2024) posits that online learning necessitates heightened motivation, as the learning environment typically relies on motivation and associated traits such as curiosity

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and self-regulation to facilitate engagement in the learning process. Motivation is regarded as a crucial determinant of learning success, particularly in online learning environments. Consequently, it is essential to reevaluate learning motivation in technologically mediated educational contexts (Randi & Corno, 2022; Zhou & Zhang, 2024) . Therefore, it is imperative for educational researchers to conduct an in-depth examination of student motivation in online learning, especially concerning the learning activities undertaken curried out following the Coronavirus Disease Pandemic (Covid-19).

In facilitating online education, both instructors and students must adequately prepare for the learning process. The preparations required by educators and learners pertain to pedagogical relationships between instructors and students, as well as learning resources (media, subjects, platform applications, and network access) (Fitriyani et al., 2020) . The provision of designed teaching materials is a strategy to enhance student motivation (Adhikari et al., 2025) . Teaching materials designed for the learning process, namely student worksheets, may be shortened as SW. Patterns of student worksheets transitioning from teacher-centered to student-centered (Muttakin, 2017) . Student worksheets comprise content, summaries, and assignments that students are required to complete. The availability of student worksheets remains limited and ineffective as a pedagogical resource. When generating student worksheets, the instructor must fulfill various standards. A worksheet must fulfill the components and qualities pertinent to the mastery of a basic competency by student. Student worksheets are not merely a compilation of questions; rather, they represent the sequential activities undertaken by students to enhance their understanding, which may include questions as a component.

The availability of worksheets is expected to increase student motivation to learn independently using student worksheets, and it can be seen that their effects on learning outcomes are increasing. The results of the study (Prastii et al., 2019), showed that by using student worksheets that had met valid, practical and effective criteria in mathematics courses, 77% of students felt challenged and motivated. Empirical findings from this study in line with theoretical reviews put forward by (Irdalisa et al., 2024; Prastii et al., 2017) that at least 80% of students are motivated to study about subjects in student worksheets and solve problems/projects independently in their respective groups.

However, previous studies that developed student worksheets to enhance learning motivation have been limited to elementary school students. A study (Sasongko et al., 2025) found that student worksheets were valid, practical, and quite effective in increasing students' learning motivation among students in Class X at Almaarif Singosari Senior High School. Similarly, a study (Sumandya et al., 2025) found that student worksheets significantly increased students' motivation to learn mathematics, with the study subjects being students in Class VIII-G at SMPN 8 Denpasar. Furthermore, a study (Eriana et al., 2024) found a relationship between the use of e-worksheets and students' learning motivation in classes VII F and VII G at SMPN 1 Bantarkawung. Therefore, it is essential to conduct research on the development of student worksheets for university students, particularly those in the mathematics education department who are taking advanced calculus courses.

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Consequently, advanced calculus classes are essential for developing a student worksheet that enhances incentive to learn. The heightened internal and external motivation for students to engage in independent learning among challenges in advanced calculus positively influences their academic performance in the subject. This study aims to create valid, practical, and effective student worksheets for advanced calculus classes to enhance student motivation.

Research Methods

This research involves the creation of student worksheets aimed at enhancing students' learning motivation. This research was conducted during the even semester of the 2025/2026 academic year in the Mathematics Education program at STKIP Andi Matappa, located at 70 A. Mauraga Street, Pangkajene Pangkep Regency, South Sulawesi. The participants were third-semester 20 students enrolled in the Advanced Calculus course of the Mathematics Education program at STKIP Andi Matappa. Participants were selected using purposive sampling.

Research Flow Chart

For the development of student worksheets using the Plomp model (Fajriah & Suryaningsih, 2020; Nasution et al., 2021; Purwati, 2019)that will be used in this study which consists of 5 stages, namely: (1) initial investigation, (2) design, (3) realization or construction, (4) tests, evaluations & revisions, and (5) implementation show in Figure 1.

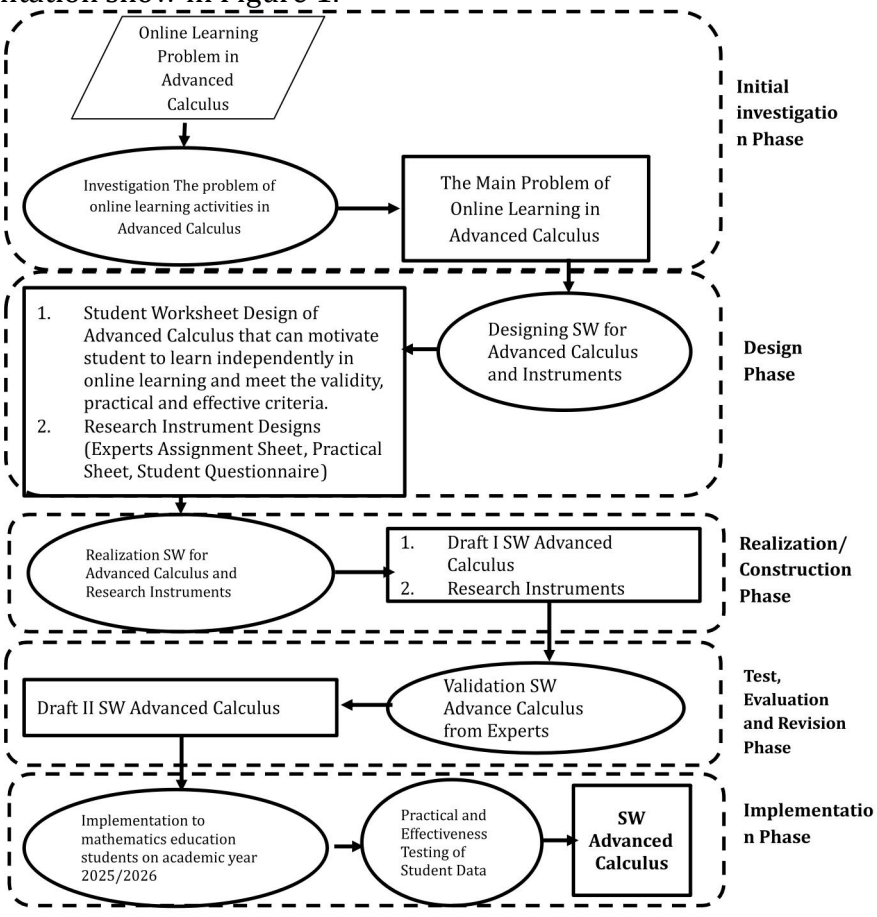

Figure 1. Flowchart of Plomp Model Development Research

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The instruments utilized in this study included: (1) a validation sheet for student worksheets; (2) practicality sheets for student worksheets; and (3) a questionnaire assessing student motivation. The data gathered in this investigation are: (1) Validation of student worksheet data; (2) Practicality of student worksheets; (3) Data about student motivation.

Analysis of Data validity of Student Worksheet

The content validity of student worksheets is evaluated by the review of two experts utilizing Gregory's content validity method (Ibrahim et al., 2023; Spoto et al., 2025; Taqwa, 2021; Taqwa & Taufik, 2019c) . The evaluation standards of the two validators need a minimum of "strong relevance". If the content validity coefficient values are elevated (V>75%), it can be asserted that the outcomes of the measurements or interventions conducted are valid.

Practical Data Analysis for Student Worksheets

The practical category of student worksheets determined by 20 students with a number of questions: 17 items using the data conversion based on the criteria presented in the following Table 1 below:

Table 1. Practical Criteria for Student Worksheets

No	Total Score Interval	Score	Category
1	$\frac{5}{6}.5.m.n < X \leq 1.5.m.n$	$708 < X \leq 850$	Very Practical
2	$\frac{4}{6}.5.m.n < X \leq \frac{5}{6}.5.m.n$	$567 < X \leq 708$	Practical
3	$\frac{3}{6}.5.m.n < X \leq \frac{4}{6}.5.m.n$	$425 < X \leq 567$	Enough Practical
4	$\frac{2}{6}.5.m.n < X \leq \frac{3}{6}.5.m.n$	$283 < X \leq 425$	Less Practical
5	$\frac{1}{6}.5.m.n < X \leq \frac{2}{6}.5.m.n$	$142 < X \leq 283$	Not Practical

Source: (Taqwa & Taufik, 2019a)

Analysis of the Effectiveness of Student Worksheet Data

The effectiveness analysis of student worksheets in fostering student learning motivation using descriptive and inferential analysis using test marks one sample because the data is not distributed by utilizing software RStudio. The questionnaire of motivation which improve based MLSQ (Motivated Strategies for Learning Questionnaire) totaling 32 points ordinal scale is converted into an interval scale by means of the Method of Successive Intervals (MSI) (Green, 2017) using the software RStudio (Taqwa, 2021; Taqwa et al., 2021) . Before analyzed inferentially, the data of student learning motivation was analyzed by descriptive analysis, with categorize according to the following Table 2 below:

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Table 2. Student Learning Motivation Criteria Table

No	Total Score Interval	Score	Category
1	$Mi + 1{,}5SDi < X$	$236 < X$	Very High
2	$Mi + 0{,}5SDi < X \leq Mi + 1{,}5SDi$	$155 < X \leq 236$	High
3	$Mi - 0{,}5SDi < X \leq Mi + 0{,}5SDi$	$73 < X \leq 155$	Enough
4	$Mi - 1{,}5SDi < X \leq Mi - 0{,}5SDi$	$2 < X \leq 73$	Less
5	$X \leq Mi - 1{,}5SDi$	$X \leq 2$	Very Less

Source: (Taqwa & Taufik, 2019b)

According to (Trisnawati et al., 2019) , the criteria for the effectiveness of development used in terms of learning motivation is the average minimum score of learning motivation, so that in this study the minimum completeness criteria (KKM) of students' learning motivation taken is in the enough category which is the motivation value of more than 73 .

Results and Discussion

Results

Initial Investigation Phase

The result of the initial investment phase show that the constraints faced by the students in learning the subjects of Advanced Calculus is the lack of teaching materials that accommodate independent learning and conditions lecturer in North Maluku so that changes in the learning system at further calculus courses are replaced with online learning.

Not all students will succeed in online learning, it is caused by differences in learning environment factors and student characteristics. One of the successes in learning is related to the motivation of students. Student worksheets are one of the teaching materials that are able to motivate students to learn the materials in student worksheets and solve problems / projects independently in their respective groups. Lectures online with student worksheets full steps to resolve and bonus squares will make students feel not weary and motivated. It is developing the student worksheets of advanced calculus to achieve it.

Design Phase

The Design Phase, the researcher arranges the material for Advanced Calculus courses, arranges indicators for each research instrument, and the online learning stages that will be used. These materials are (1) Polynomial Function (SW 1); (2) Partial Derivatives (SW 2); (3) Limit and Continuation (SW 3) ; (4) Differential of Polynomial Function (SW 4); (5) Derivatives of Polynomial Functions (SW 5); (6) Gradient Polynomial Function (SW 6); (7) Tangent Sector (SW 7); (8) Chain Rules of Multiple Variable (SW 9); (9) Maximum and Minimum Value of Polynomial Functions (SW 10); (10) Double Integral over Displayed Square and Repeated Integral (SW 11); (11) Double Integral over the top of Non-Rectangle (SW 12) ; (12) Double Integral in polar coordinates (SW 13) ; (13) Surface Area and Triple Integral (SW 14) and (14) Triple Integral of Cylinder Coordinates (SW 15) . The indicator for the SW validity sheet instrument consists of 17 statements related to (1) format; (2) Language; (3) contents; (4) illustration and layout of diagrams; and (5) time. The SW practicality sheet consists of 17 statements with indicators: (1) time; (2) usage; and (3) benefits. The student

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learning motivation questionnaire consisted of 32 statements with indicators: (1) orientation of intrinsic goals; (2) orientation of extrinsic goals; (3) assignment value; (4) control of learning beliefs; (5) self-efficacy for learning and performance; and (6) anxiety tests.

Realization / Construction Phase

At the phase of realization / Construction, researchers realize Draft I student worksheets advanced calculus and instruments are used in research that sheet validity of student worksheets, sheet practicality student worksheets, and inquiry learning motivation of students.

Test, Evaluation and Revision Stage

The test phase, evaluation, and revision of the draft I student worksheets were evaluated by two experts are experts in the field of mathematics education with the validity of the technique. The results of the analysis of the validity of the contents of the instrument. shown in Table 3 below:

Table 3. Results of the Validation of the contents of the Student Worksheet

No	Indicator	Validator	
		1	2
1	Clear numbering system	4	4
2	Clear troubleshooting instructions	2	4
3	Spatial / layout settings	4	3
4	Type and size of letters accordingly	4	3
5	The use of language in terms of the use of Indonesian language rules.	4	4
6	Clarity of instructions / direction, comments and problem solving.	3	4
7	Simplicity of sentence structure.	3	3
8	The language used is communicative	4	4
9	The truth of the contents / material in the worksheet of students is in accordance with mathematical concepts	4	4
10	The suitability of the order of solving the problem is clear.	3	4
11	Compliance with online learning	4	4
12	Steps to resolve and bonus squares in student worksheets accordance with the theories of motivation to learn mathematics,	4	4
13	Student worksheets are accompanied by illustrations, tables, or diagrams that relate directly to the subject matter or concepts discussed.	2	4
14	Illustrations, tables, or diagrams are made in an effective order.	2	3
15	Illustrations, tables, or diagrams are used to clarify concepts / materials.	3	4
16	Interesting illustration, table, or diagram, clearly legible and easy to understand.	3	4
17	Rationality of time allocation for completing student worksheets	3	3

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$$Content\ Validity = \frac{D}{A+B+C+D} = \frac{14}{17} = 0{,}82$$

The results of the analysis of the validity of the contents of a student worksheet demonstrated content validity scores were 0,82 which means that the validity of the contents of a student worksheet categorized as very high. Continue that draft I student worksheets fit for use in advanced calculus courses as a means of supporting learning activities online to motivate student learning. Although it is well worth going to but there are still some improvements in accordance with a second validation expert assessment conclusions that MFIs can be used with minor revisions. The minor revisions were made according to the advice of the two experts, namely the addition of examples in student worksheets and the provision of guidelines for giving bonuses. For example, the change in Draft I of Student 1 worksheet to Draft II of Student 1 worksheet is as follows shows in Figure 2 - 4:

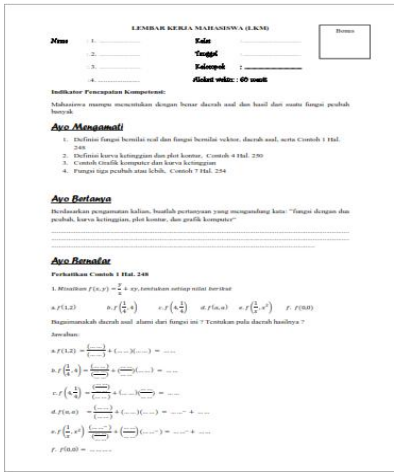


Figure 2. Draft I Student Worksheet 1

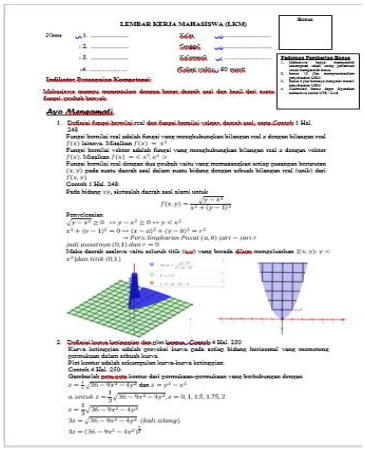
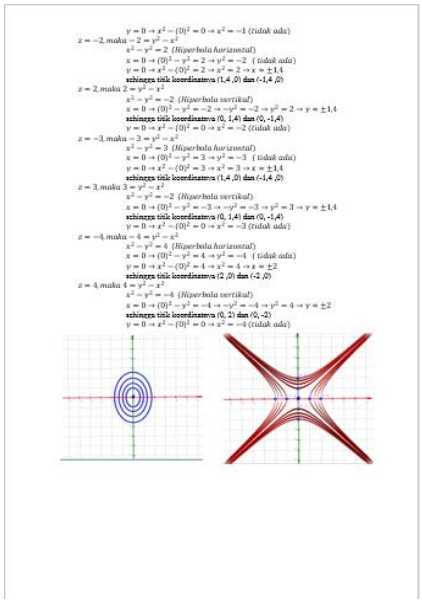


Figure 3. Draft II Student Worksheet 1



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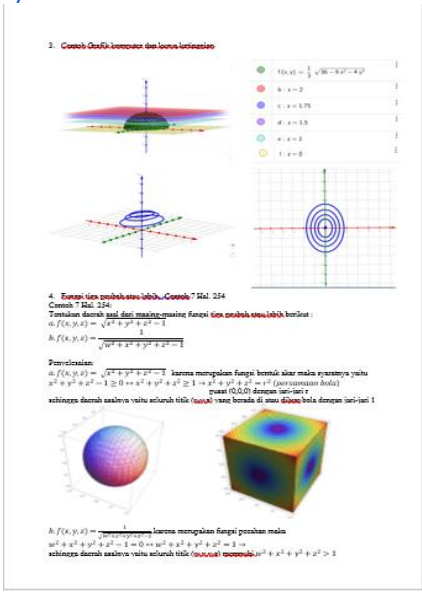

Figure 4. Draft II Student Worksheet 1

Phase I Implementation

The Implementation Phase is carried out 14 meetings using Draft II worksheets for advanced calculus students starting on 19 August 2025. Advanced Calculus lectures are conducted every Thursday at 07.30–09.00 online via the Zoom application at Spada STKIP Andi Matappa. At the first meeting, the researcher said that with online learning that prioritizes independent learning, some students will have difficulty in completing and understanding the concept of advanced calculus. This difficulty can be overcome by the students themselves if they realize how important, and how useful the concepts are taught so that they are motivated to find out assisted by teaching materials that direct the concepts to be easy, challenging, in exploring, analyzing, and completing each concept such as student worksheet of advanced calculus. Researchers open assignment access of student worksheets each meeting in Spada STKIP Andi Matappa with a platform LMS Moodle two days prior to the course to be completed by students independently with the help of textbooks that Calculus issue of the eighth volume of the second by Purcell et al, researcher shows alternately every meeting one of the students to be responsible for presenting correct subjects on the student worksheets the At the lecture progresses, researcher will be positioned as a moderator and give the opportunity to students to present correct subject on the online student worksheets via features shared screen Zoom for 30 minutes, researchers give a chance for students who present his subjects to choose another student for solving the problem that had prepared step solution in a student worksheets through a screen share feature Zoom 30 minutes, researchers give a chance to other students who have any questions on the chat feature Zoom to ask for 15 minutes, researchers give bonuses to students who presented and asked about the resolution of a problem on the student worksheets. The Purpose of Chances to the present problem-solving from worksheets and asked to allow students to know the procedures manual count and gain rewards in the bonus box used when Middle/Final Examination. The activity was conducted by researchers to motivate students to learn student worksheets advanced calculus and resolve problems in a student worksheet be independent. In the last Meeting, Lecturing

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closed with the provision of sheets practicality student worksheets and student motivation questionnaire. The analysis of the practicality of student worksheets by students are shown in Table 4 below:

Table 4. Summary of Practical Textbook Assessment by Students

Item	Score Product SW
1	37
2	37
3	43
4	40
5	37
6	37
7	42
8	41
9	38
10	42
11	40
12	44
13	43
14	42
15	44
16	41
17	42
Total	690

To determine the practicality categorization student worksheets student used data conversion based on the criteria presented in Table 5 below:

Table 5. Practical Criteria for Student Worksheets

No	Total Score Interval	Category
1	$708 < X \leq 850$	Very Practical
2	$567 < X \leq 708$	Practical
3	$425 < X \leq 567$	Enough Practical
4	$283 < X \leq 425$	Less Practical
5	$142 < X \leq 283$	Not Practical

Results of student assessment showed that the total score is 690 from an ideal score of 850, so that student worksheets included in the category of "practical" so student worksheet fit for use in the learning process online to motivate students in learning mathematics.

The Data of student learning motivation were analyzed effectiveness level by using descriptive and inferential analysis which is using Sign Test One sample (Test Signs One sample) with software R studio.

Posttest Descriptive Analysis of Student Learning Motivation

Data student motivation on an ordinal scale is converted to an interval scale by means of the successive interval method (MSI) analyzed using R Studio software and produces descriptive statistical values as follows Figure 5 below:

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	X..Motivasi.X
nobs	10.000000
NAs	0.000000
Minimum	95.951006
Maximum	148.057061
1. Quartile	106.823887
3. Quartile	138.700254
Mean	122.351109
Median	123.227234
Sum	1223.511086
SE Mean	5.843052
LCL Mean	109.133206
UCL Mean	135.569011
Variance	341.412605
Stdev	18.477354
Skewness	0.026036
Kurtosis	-1.719226

Figure 5. Posttest Descriptive Statistics Output Student Learning Motivation

Based on Figure 5 it can be seen that the average value of learning motivation is 122,35 from an ideal score of 195,56 , and the standard deviation is 18,48. Because the standard deviation value is relatively large , then the distribution of data is not homogeneous (uneven) of each category so that the possibility of data comes from populations that are not normally distributed , this can be seen in the following histogram in Figure 6 bellow:

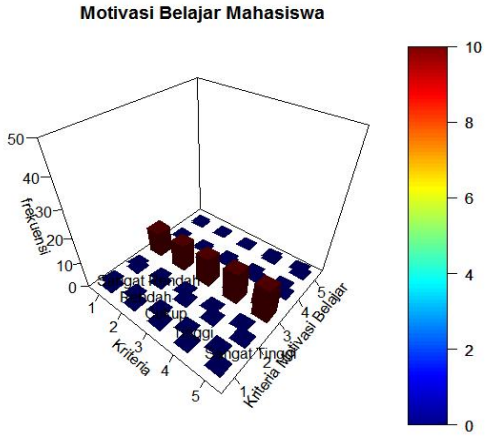

Figure 6. Student Learning Motivation Histogram

From Figure 6 shows that the spread of the percentage of data dissemination posttest learning motivation of students based on criteria for distributing student interval that is in sufficient criteria se no more than 20 students (100%), while the motivation to learn other criteria do not exist. In addition, it was seen that the enough criteria ($73 < X \leq 155$) there was an average mathematics learning motivation of 122,35 with a standard deviation of 18,48.

Inferential Analysis

Normality test

For more details, the normality test results are presented in the following Figure 7 bellow:

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```
        Shapiro-Wilk normality test

data:  Motivasi$X
W = 0.93525, p-value = 0.5015
```

Figure 7. Normality Test for Student Learning Motivation Data

The results of the analysis of student learning motivation data indicate the value of p = 0, 5015 ≥ alfa= 0,05. This shows that the sample of student learning motivation data comes from populations that are not normally distribution. Because of the small sample size consideration, a non-parametric test was performed. One of the nonparametric tests that can be used for one sample is the One Sample Sign Test.

Hypothesis testing

The minimum completeness criteria (KKM) of students' learning motivation taken is in the sufficient category which is the motivation value of more than 73, so the hypothesis

H0: Median of student learning motivation by treatment student worksheets advanced calculus maximum in the low category (≤73)

H1: Median of student learning motivation by treatment student worksheets advanced calculus fairly minimal in the category (>73)

The Statistical Hypothesis: H0: m ≤ 73 versus H1: m > 73

further with the help of software RStudio then testing hypotheses and generate output as Figure 8 below:

```
        One-sample Sign-Test

data:  Motivasi$X
s = 10, p-value = 0.001953
alternative hypothesis: true median is not equal to 73
95 percent confidence interval:
 104.1978 142.7421
sample estimates:
median of x
   123.2272
```

Figure 8. Output Sign Test One Sample Student Learning Motivation

Results Sign Test One sample showed the value of p = 0.001953 < alfa= 0,05, it can be concluded sufficient evidence for download megrim H_0 , so based on these data, median student learning motivation by treatment student worksheets of advanced calculus minimal in the category enough, medians learning motivation of students is greater than 73 with 95% , it can be concluded that the treatment of the provision of student worksheets advanced calculus effectively influence the learning motivation of students in courses advanced calculus .

Discussion

From the perspective of content validity, student worksheets shown a high level of content validity. Persist in utilizing student worksheets as a resource to enhance online learning activities in advanced mathematics courses, particularly amid online learning, to bolster student motivation. The validity of the generated student worksheets is directly proportionate to the research findings (Prastii et al., 2019), which indicate that worksheets meeting valid criteria can enhance student learning motivation; indeed, 77% of students report feeling challenged and

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encouraged to engage in autonomous learning. This aligns with online education that emphasizes autonomous learning. Furthermore, aligned with markers of learning motivation regarding student intrinsic goal orientation, the tough material in the student worksheet facilitates the acquisition of new knowledge(Sasongko et al., 2025; Sumandya et al., 2025).

If viewed from the aspect of practicality by students shows that student worksheets included in the category of " practical" so student worksheets fit for use in online learning. These empirical findings are supported by the results of the study (Sasongko et al., 2025) who said student worksheet which is developed relatively practical if it can be applied in the learning process as well without any problems which may interfere with the learning process. It means that students worksheets are practically able to facilitate lecturers and students (Celik et al., 2022; Lestari et al., 2023; Taqwa, 2023; Taqwa & Taufik, 2019a, 2019b; Zulyadaini, 2017) . It is seen that the activity of student worksheets easily accommodated students' learning motivation. It is Reasonable to suspected motivation that comes from the aspect of assignments value and anxiety when test, about questions in student worksheets calculus equipped with steps work will facilitate the students will work on the problems test advanced calculus is relatively the same so as to obtain a high score. Especially during the difficult times of online education, which demanded online learning. This is in line with research (Taqwa, 2017), which says that the ease factor when difficulties in solving math problems as well as the value reward factor can affect the motivation to learn mathematics.

If viewed from the aspect of effectiveness, treatment provision of student worksheets advanced calculus effective shortly grow learning motivation of students in advanced calculus course. This finding is consistent with theoretical overview presented by (Wahyuni & Kurniawan, 2019) that the use of student worksheets be effective if in the process of learning the material student worksheets has adapted to the needs of the students. Because according to student necessary, then students found subject in student worksheets in advanced calculus course is very helpful to learn. These characteristics are consistent with the characteristics of student learning motivation, especially in the dimensions of the value of the task and control of learning beliefs (Albashtawi & Al Awabdeh, 2023; Berestova et al., 2022; Hariri et al., 2021; Poot et al., 2017; Putri & Oktaria, 2017; Wang & Liou, 2017; Wass et al., 2023). This is because, according to (Albashtawi & Al Awabdeh, 2023; Berestova et al., 2022; Poot et al., 2017; Putri & Oktaria, 2017; Wang & Liou, 2017) in the dimensions of assignment, students will assess how attractive, how important, and how useful the assignments are given in this case the student worksheet while the dimensional control of learned beliefs, the students will try to use the strategy and effectively as possible in learning example resolve a matter / matter in the student worksheets . In fact, according to (Hačatrjana & Linde, 2023; Prastii et al., 2019; Sari & Putri, 2020; Widodo et al., 2023) , 80% of the students will be motivated to solve the problem / project student worksheets independently in each group due to the materials in student worksheet.

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Conclusion and Suggestion

The purpose of this study was developing student worksheets in advanced calculus courses that were valid, practical, and effective in fostering student motivation. The results showed that the student worksheets that had been developed had met the valid, practical and effective criteria. The level of student work developed in this study needs to be continued by applying it more broadly. The wider application results will make this student worksheet better in increasing the motivation to learn from STKIP Andi Matappa students. In addition, the results of the identification of the characteristics of advanced calculus courses indicate the possibility of using computers in some materials. The use of computers in tutorials can help students explore concepts dynamically and attractively. Not only that, the use of computers can help students compete in the industrial era 4.0.

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