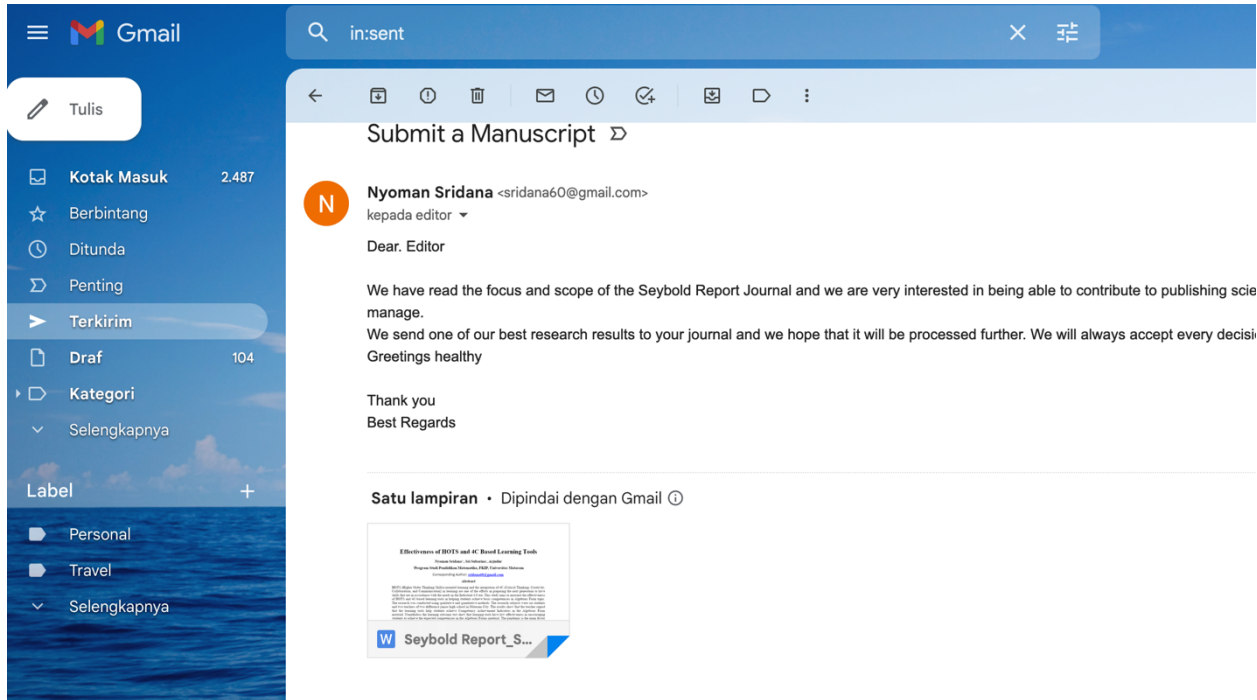


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Dr. Nyoman Sridana, M.Si

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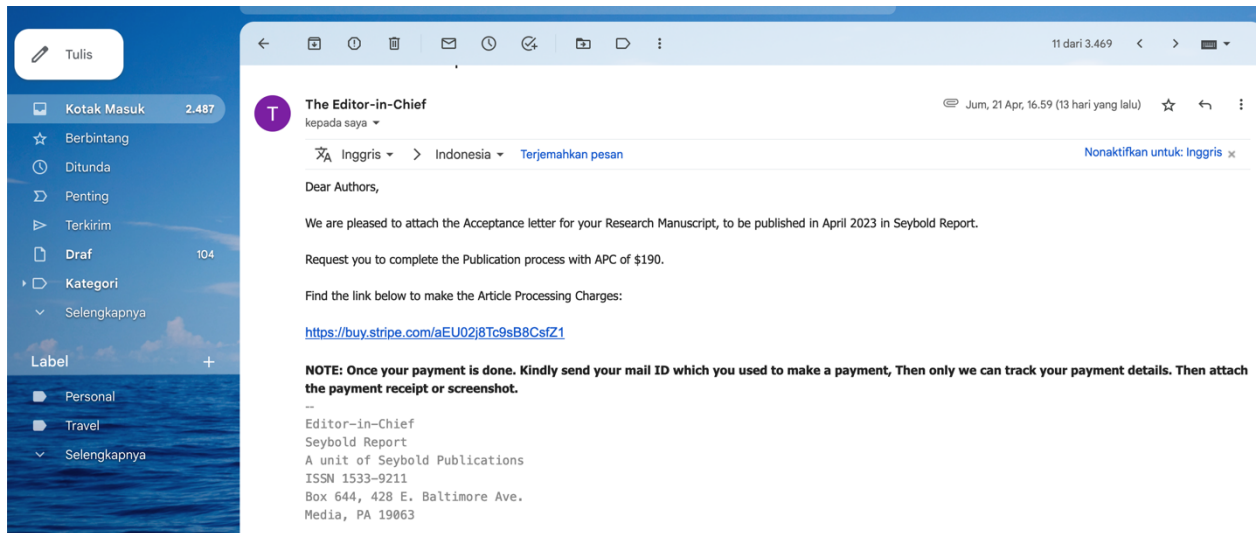
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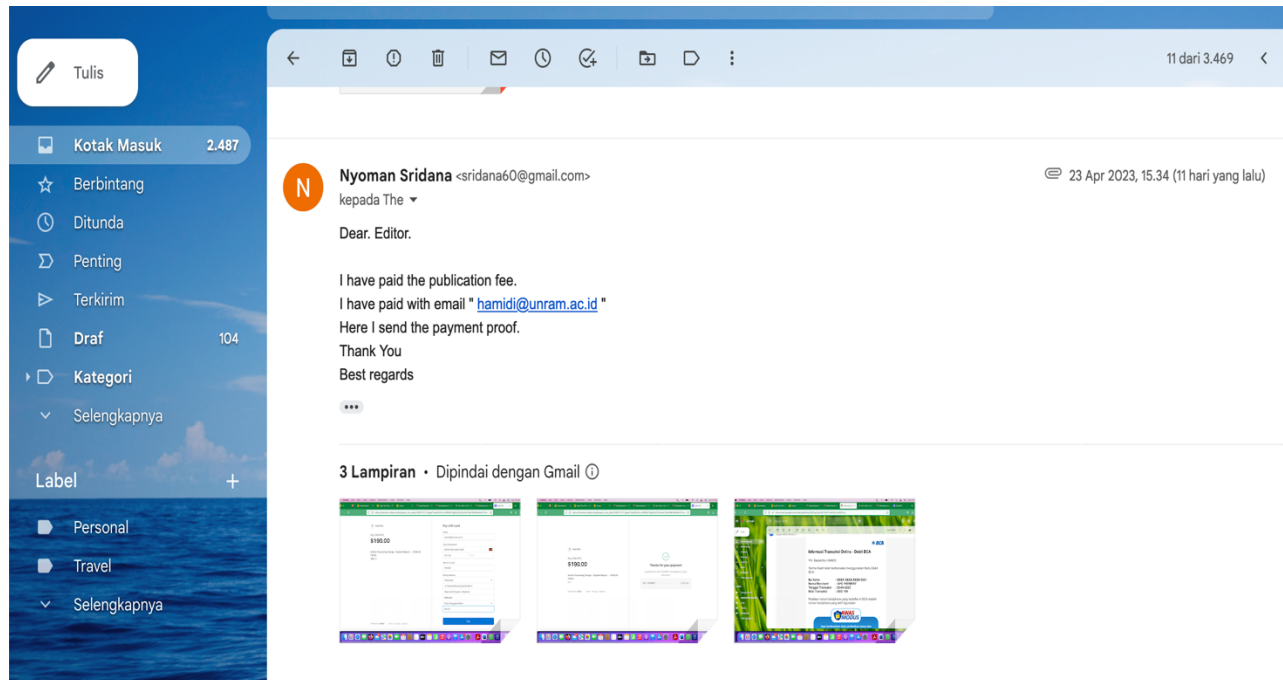
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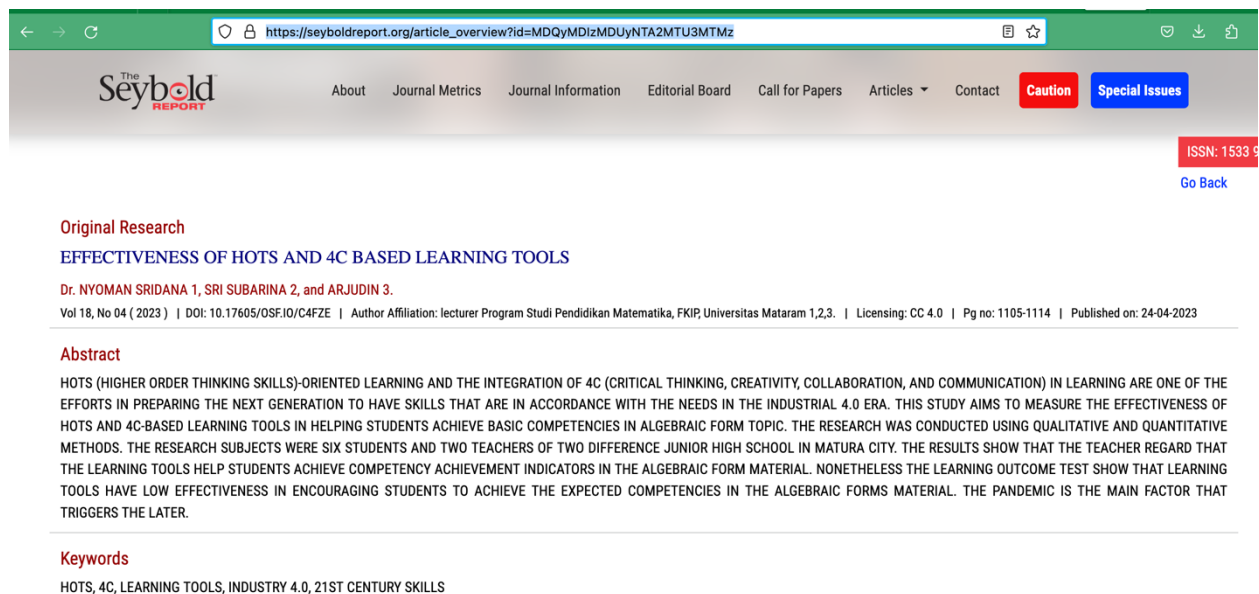


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**Original Research**  
**EFFECTIVENESS OF HOTS AND 4C BASED LEARNING TOOLS**  
Dr. NYOMAN SRIDANA 1, SRI SUBARINA 2, and ARJUDIN 3.  
Vol 18, No 04 (2023) | DOI: 10.17605/OSF.IO/C4FZE | Author Affiliation: lecturer Program Studi Pendidikan Matematika, FKIP, Universitas Mataram 1,2,3. | Licensing: CC 4.0 | Pg no: 1105-1114 | Published on: 24-04-2023

**Abstract**  
HOTS (HIGHER ORDER THINKING SKILLS)-ORIENTED LEARNING AND THE INTEGRATION OF 4C (CRITICAL THINKING, CREATIVITY, COLLABORATION, AND COMMUNICATION) IN LEARNING ARE ONE OF THE EFFORTS IN PREPARING THE NEXT GENERATION TO HAVE SKILLS THAT ARE IN ACCORDANCE WITH THE NEEDS IN THE INDUSTRIAL 4.0 ERA. THIS STUDY AIMS TO MEASURE THE EFFECTIVENESS OF HOTS AND 4C-BASED LEARNING TOOLS IN HELPING STUDENTS ACHIEVE BASIC COMPETENCIES IN ALGEBRAIC FORM TOPIC. THE RESEARCH WAS CONDUCTED USING QUALITATIVE AND QUANTITATIVE METHODS. THE RESEARCH SUBJECTS WERE SIX STUDENTS AND TWO TEACHERS OF TWO DIFFERENCE JUNIOR HIGH SCHOOL IN MATURA CITY. THE RESULTS SHOW THAT THE TEACHER REGARD THAT THE LEARNING TOOLS HELP STUDENTS ACHIEVE COMPETENCY ACHIEVEMENT INDICATORS IN THE ALGEBRAIC FORM MATERIAL. NONETHELESS THE LEARNING OUTCOME TEST SHOW THAT LEARNING TOOLS HAVE LOW EFFECTIVENESS IN ENCOURAGING STUDENTS TO ACHIEVE THE EXPECTED COMPETENCIES IN THE ALGEBRAIC FORMS MATERIAL. THE PANDEMIC IS THE MAIN FACTOR THAT TRIGGERS THE LATER.

**Keywords**  
HOTS, 4C, LEARNING TOOLS, INDUSTRY 4.0, 21ST CENTURY SKILLS

# Effectiveness of HOTS and 4C Based Learning Tools

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## Abstract

**HOTS** (Higher Order Thinking Skills)-oriented learning and the integration of **4C** (Critical Thinking, Creativity, Collaboration, and Communication) in learning are one of the efforts in preparing the next generation to have skills that are in accordance with the needs in the Industrial 4.0 era. This study aims to measure the effectiveness of HOTS and 4C-based learning tools in helping students achieve basic competencies in Algebraic Form topic. The research was conducted using qualitative and quantitative methods. The research subjects were six students and two teachers of two difference junior high school in Mataram City. The results show that the teacher regard that the learning tools help students achieve Competency Achievement Indicators in the Algebraic Form material. Nonetheless the learning outcome test show that learning tools have low effectiveness in encouraging students to achieve the expected competencies in the Algebraic Forms material. The pandemic is the main factor that triggers the later.

Commented [Reviewer1]: Abstract Must be Clearly

Keywords: HOTS, 4C, Learning Tools, Industry 4.0, 21st Century Skills

## INTRODUCTION

The development of the use of digital technology seems unavoidable in this era (Jadertriweiler et al., 2019). The Industrial Era 4.0 is the main reason for the start of massive digitalization in every aspect of life in the 21st century (Sima et al., 2020). Starting from human labor being replaced by machines to the emergence of various new types of work, this is the impact of the Industrial 4.0 era (Gandasari et al., 2020; Memon & Ooi, 2021).

In 2020-2030, Indonesia will enjoy the Demographic Bonus (Wisnumurti et al., 2018). This phenomenon occurs when the number of Indonesian population in productive age (14 – 64 years) is more than the population with unproductive age (less than 14 years or more than 64 years) (Rostiana & Rodesbi, 2020; Warsito, 2019). Of course, this can be an opportunity for Indonesia in an effort to increase national development (Hendratno & Fitriati, 2016; Oey-Gardiner & Gardiner, 2013).

Therefore, it is a challenge for Indonesia in this Industry 4.0 era to be able to take advantage of the Demographic Bonus (Ilyas et al., 2020). Because the Demographic Bonus can also be a threat to Indonesia. One of the threats that lurk is educated unemployment which often occurs due to the skills possessed are not in accordance with what is needed at that time (Gandasari et al., 2020; Memon & Ooi, 2021; Nambiar et al., 2019). So that the provision of the next generation to have the appropriate skills needed in this Industry 4.0 era needs to be done (Ana et al., 2018).

HOTS (Higher Order Thinking Skills)-oriented learning and the integration of 21st century skills in learning is one of the efforts in preparing the next generation to have skills that are in accordance with the needs in the Industrial 4.0 era (Tangahu et al., 2021). HOTS-based learning is learning that focuses on supporting and facilitating students' critical thinking skills so that they become problem solvers (Fanani, A., & Kusmaharti, 2014; Firmadani & Wulansari, 2020). In this era, HOTS-based learning is needed so that the competence of students can follow the development of science and technology so that they have the competencies needed today (Sudana et al., 2020). The 21st century skills that must be possessed by students today are 4C competencies, namely Critical Thinking, Creativity, Collaboration, and Communication (Selman & Jaedun, 2020; Suyitno et al., 2021).

So it is the teacher's obligation to prepare and equip students to have 21st century skills through HOTS-based learning (Pratiwi & Mustadi, 2021). However, in reality there are still many teachers who still have not implemented this. Learning is still teacher-centered where students play more of a role as listeners. Whereas learning in the 21st century should shift to student-centered learning (Sumardi et al., 2020).

According to one teacher, the reason this happens is that there are still many students who even have difficulty in teacher-centered learning. Especially in learning mathematics, there are still many students who do not understand basic mathematical concepts such as integer or fractional operations (Sridana et al., 2020). In addition, according to one teacher, the average reading interest of students is low, causing them to prefer learning by listening to the teacher's explanations rather than looking for themselves through reading books or other sources.

Even so, HOTS-based learning must still be implemented. Apart from its advantages, the 2013 Curriculum has also mandated that HOTS-based learning be used in the teaching and learning process (Yayuk et al., 2019). Students have difficulty because they are not familiar with the learning process. This research is a continuation of previous research on the development of HOTS-based learning tools. The focus of this research is to measure the effectiveness of the tools that have been developed (RPP, LKPD, and teaching materials).

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## RESEARCH METHODS

This research is a mix of qualitative and quantitative descriptive methods. Collecting data using test and interview methods. The research subjects were six seventh grade students from six public junior high schools in Mataram City, West Nusa Tenggara. Qualitative data will be processed descriptively. The data in quantitative form will be converted into qualitative descriptive data. Quantitative data will first be processed into percentage form, with the following formula:

$$\text{Percentage } (p) = \frac{\text{score}}{\text{Ideal Score}} \times 100\% \quad (1)$$

The  $p$  value was then converted into a qualitative scale with the guidelines in Table 1:

Table 1. Conversion of Learning Device Effectiveness

Score (%)	Category
$p > M_i + 1,5 (SD_i)$	Very high
$M_i + 0,5 (SD_i) < p \leq M_i + 1,5 (SD_i)$	Tall
$M_i - 0,5 (SD_i) < p \leq M_i + 0,5 (SD_i)$	Enough
$M_i - 1,5 (SD_i) < p \leq M_i - 0,5 (SD_i)$	Low
$p \leq M_i - 1,5 (SD_i)$	Very low

(Rusydi & Fadhli, 2018)

## RESULTS AND DISCUSSION

### Learning Implementation Plan (known with RPP)

In the RPP adjustments are made to each activity to improve 21st century skills. The core activities in the RPP are focused on improving 4C competencies. The learning model applied is problem

Deleted: Learning Implementation Plan (RPP).

based learning (PBL) which facilitates learning conditions with HOTS-based tools (Firmadani & Wulansari, 2020).

The HOTS-based lesson plans used in this study with the impact of 4C competencies is displayed in Table 2.

Table 2. Integration of 4C Competencies in RPP

No.	Core activities	4C Kompetensi Competence
1	The teacher organizes students into 5 heterogeneous groups and students sit based on the groups that have been created.	<i>Collaboration</i>
2	Students understand the procedures for working on HOTS-based worksheets delivered by the teacher.	<i>Collaboration, Communication, Critical Thinking, Creativity</i>
3	Students start working on the worksheets that have been distributed.	
4	The teacher ensures that there is a division of roles in the group.	<i>Collaboration</i>
5	Each group is given the opportunity to seek information from other sources to help solve problems in the HOTS-based LKPD	<i>Collaboration, Communication, Critical Thinking, Creativity</i>
6	The teacher randomly appoints two groups to present the results of their discussion, while the other groups respond.	

Table 2 shows the integration of 4C competencies in core activities in the RPP. Thus, using HOTS-based lesson plans, especially the PBL model, can train all 4C competencies that must be possessed by students. For example in activity number 3, in this activity students will work on LKPD in groups (Collaboration). Of course, discussions between group members will be carried out (Communication). In the process of solving problems in LKPD students will practice their ability to identify, analyze, and evaluate information (critical thinking) or problems and combine various ideas or information into a solution to a given problem (creativity). (R. Kelley et al., 2019; Wiedarti, Pangesti; Laksono et al., 2019).

In addition, the RPP indirectly helps students develop the characters needed to support 21st century skills. In general, there are six characters that can support 21st century skills, namely mindfulness, curiosity, leadership, courage, resilience, and ethics. (Horvathova et al., 2015). However, in terms of character building, Indonesia associates it with Pancasila (Figure 1). So that there are five 21st century characters in Indonesia which became known as Strengthening Character Education, namely religious, national, independent, mutual cooperation, and integrity. (Wiedarti, Pangesti; Laksono et al., 2019).

For example in core activity number 1, making students work in a group can practice the values of Pancasila, namely religious which is reflected in learning to be tolerant and mutual cooperation which is reflected in the attitude of solidarity, mutual help and kinship. Based on the teacher's comments as practitioners, the lesson plans that have been prepared have complied with the rules for making lesson plans that have been suggested by the government. In addition, the lesson plans can also help increase

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student activity in the classroom and help guide students' higher-order thinking skills and 21st century skills.

### Student Worksheet

The Student Worksheet developed is a HOTS-based student worksheet that refers to PBL, namely student worksheet using the PBL syntax. In this study, student worksheet will be done in groups by students. Based on previous research, the use of HOTS-based worksheets with a PBL approach can help improve students' higher-order thinking skills, critical thinking skills, creativity, collaboration and communication skills.(Herdiansyah, 2018; Purwasi & Fitriyana, 2020; Risfalidah et al., 2019; Setioso et al., 2016; Sulaiman & Shahrill, 2015; Umriani et al., 2020).

Table 3. Adaptation of PBL syntax and 4C integration in LKPD

No.	Student Worksheet Section	Stages	4C Kompetensi Competence
1	<p><b>a. Bentuk Aljabar dan Unsur-unsurnya</b></p> <p>Perhatikan ilustrasi berikut</p> <p><b>Bentuk Aljabar, Variabel, Konstanta, dan Faktor</b></p> <p>Seorang anak setiap hari diberikan uang saku yang besarnya tetap, yaitu Rp. 10.000,00. Selain itu setiap akhir pekan, ditambah uang saku akhir pekan sebesar Rp. 35.000,00. Jumlah uang saku yang diterima anak tersebut dalam seminggu adalah <math>70.000 + 35.000 = 105.000</math> rupiah.</p> <p>Jika uang saku tiap hari dimisalkan <math>x</math>, maka jumlah uang saku yang diterima dalam seminggu adalah <math>7x + 35.000</math></p> <p>Bentuk <math>7x + 35.000</math> ini dikenal dengan bentuk aljabar. Istilah-istilah yang terkait dengan bentuk aljabar <math>7x + 35.000</math> adalah sebagai berikut:</p> <ul style="list-style-type: none"> <li><math>x</math> disebut variabel atau peubah</li> <li>7 disebut koefisien, yaitu bilangan yang melekat pada variabel</li> <li><math>7x + 35.000 = 7(x + 5.000)</math> merupakan perkalian antara 7 dan <math>x + 5.000</math>, atau 1 dan <math>7x + 35.000</math>. Oleh karenanya faktor dari <math>7x + 35.000</math> adalah 1, <math>7</math>, <math>x+5.000</math>, dan <math>7x+35.000</math></li> <li>25.000 disebut konstanta</li> </ul>	Student orientation on the problem	critical thinking
2	<p>Anggota Kelompok :</p> <p>1) _____</p> <p>2) _____</p> <p>3) _____</p> <p>4) _____</p> <p>5) _____</p> <p>Kerjakan soal-soal pada LKPD ini secara berkelompok 4-5 lima orang.</p>	Organizing students to study together in groups	Collaboration

3	<p>Aktivitas</p> <ol style="list-style-type: none"> <li>1. Lakukan pengamatan di dalam kelas kalian. Catatlah banyak meja, kursi, dan lemari. Meja = ..., kursi = ....., lemari = ...</li> <li>2. Apabila diketahui harga tiap-tiap benda yang diamati adalah sebagai berikut: <ul style="list-style-type: none"> <li>• Harga meja = 2 kali harga kursi</li> <li>• Harga lemari = 5 kali harga kursi</li> </ul> </li> <li>3. Diskusikanlah dalam kelompokmu! Misalkan harga kursi adalah <math>x</math>. Tentukan bentuk aljabar dari: <ol style="list-style-type: none"> <li>a. Harga kursi seluruhnya adalah .....</li> <li>b. Harga meja seluruhnya adalah .....</li> <li>c. Harga lemari seluruhnya adalah .....</li> <li>d. Jumlah harga seluruhnya adalah .....</li> </ol> </li> <li>4. Berdasarkan jawaban no 3, lengkapi tabel berikut</li> </ol> <table border="1" data-bbox="327 750 566 846"> <thead> <tr> <th>No</th> <th>Bentuk aljabar</th> <th>koefisien</th> <th>variabel</th> <th>faktor</th> </tr> </thead> <tbody> <tr> <td>3a</td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>3b</td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>3c</td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>3d</td> <td></td> <td></td> <td></td> <td></td> </tr> </tbody> </table>	No	Bentuk aljabar	koefisien	variabel	faktor	3a					3b					3c					3d					Guiding group investigation	Creativity, Critical Thinking, Collaboration, Communication
No	Bentuk aljabar	koefisien	variabel	faktor																								
3a																												
3b																												
3c																												
3d																												
4	Develop and present the work																											
5	Analyze and evaluate the problem solving process																											

In Table 3, the PBL learning syntax adapted into the HOTS student worksheet is presented. In problem orientation activities, students are given illustrations related to the concepts being studied. The activity of organizing students is done by dividing students into several groups. In the activity of guiding the investigation, the teacher will direct students to investigate and solve problems. In the activity of developing and presenting the work, students are asked to present the results of their work and discussions with the group. Then the last part is evaluating the problem-solving process, where students are asked to complete evaluation questions.

According to teachers in previous studies, student worksheet has accommodated the literacy and numeracy abilities of students. In addition, according to other teachers' comments, the improved LKPD can also guide students to analyze story questions and improve their ability to solve HOTS-based questions (Sridana, 2020).

In this study, there are also inputs for time allocation, many activities, and questions on the LKPD to be reduced by paying attention to the current situation. Given the reduced effective hours of learning in schools due to the pandemic..

### Teaching materials

Teaching materials are prepared with the local cultural context, namely West Nusa Tenggara. At the beginning of each sub-chapter there will be a problem related to the cultural context. The use of local cultural contexts so that students are more familiarized of their own culture and traditions. In addition, this is also part of participation in supporting literacy activities in schools through cultural literacy, literacy, literacy, and numeracy which are the literacy foundations of 21st century skills.(Sridana, 2020).



In previous research, teaching materials were made to support 21st century skills. In this study, the teaching materials were refined based on HOTS. In the teaching materials, the initial description of each sub-chapter is presented with a problem. Then from these problems, students will be guided to understand the concepts that can be used to solve these problems. In the teaching materials, the evaluation questions presented are HOTS-based questions. The HOTS questions in research are based on the HOTS criteria in the revised Bloom's Taxonomy, namely analyzing, evaluating, and creating.

1. MENGENAL BENTUK ALJABAR

Suatu hari ada acara syukuran di rumah Bara dan Dara. Oleh ibunya, mereka diminta untuk mengantarkan "ares" untuk tetangga di sekitar kompleknya. Jika banyak "ares" yang diberikan oleh ibu kepada Bara lebih banyak tiga bungkus daripada Dara, maka banyak "ares" yang diberikan ibu kepada Bara adalah?

Bagaimana kalian akan menjawab masalah tersebut? Tentu jika banyak *ares* yang diberikan ibu kepada Dara diketahui dengan jelas, akan sangat mudah untuk menentukan banyak *ares* yang diberikan kepada Bara. Namun, di soal hanya

**FOJOK BUDAYA**



"ares" merupakan salah satu masakan khas suku Sunda. Dibuat dari batang pohon pisang yang masih muda. Biasanya disajikan dalam acara - acara besar seperti "Segane" (syukuran).

Figure 1. Problem Orientation

Yuk kita cari tahu kemungkinan banyak *ares* yang diberikan kepada Bara dengan mengisi tabel dibawah ini:

Banyak Dara	Banyak Bara
1	1 + 3 = 4
2	...
3	...
4	...
5	...
dst	dst

Tabel 1.1 Kemungkinan Banyak *ares* Bara

Dapat diamati dari tabel kemungkinan jawabanya sangat banyak, bahkan sampai tak terhingga. Dapatkah kalian menulis semua jawaban yang mungkin? Itulah mengapa dibutuhkan aljabar untuk memudahkan dalam menjawab masalah tersebut. Dalam aljabar, kita dapat menggantikan

Figure 2. Concept Development

In Figure 1 students are asked to explore the problems given, this is to facilitate students in improving critical thinking competence. Then in Figure 2 students are asked to work on the questions with the understanding they have. Only then at the end of the sub-chapter, they are asked to solve the problems given according to the concepts that have been studied. This is in order to support the critical thinking and creativity competencies of students. In addition, teaching materials are made as detailed as possible so that they can be used independently by students.

According to a teacher's suggestion, teaching materials should be made even more concise, especially in the concept explanation section. This is because some students are more comfortable with concise and dense teaching materials, there is no need for problem narratives and so on, straight to the point. Even though there is a narrative or story that begins each section of the teaching material, it aims to help increase the literacy interest of students. In addition, from the perception of students, the teaching materials they want to use should use contextual problems or the application of mathematics in introducing mathematical concepts. Even so, according to the teacher, the teaching materials developed have been able to help guide students to understand the material in Algebraic Forms and work on student worksheet and evaluation questions.

### Effectiveness of Learning Tools

There are six schools in Mataram City which are sampled in this study. The schools are SMPN 1 Mataram, SMPN 2 Mataram, SMPN 3 Mataram, SMPN 5 Mataram, SMPN 7 Mataram, and SMPN 8 Mataram. The effectiveness of learning tools is obtained from the results of work by students on the learning outcomes test. The effectiveness referred to in this study is the effectiveness of HOTS-based learning tools and integrated 21st century skills in helping students achieve competency achievement indicators in Algebraic Forms material. The effectiveness of learning tools is obtained from the results of learning tests conducted by students.

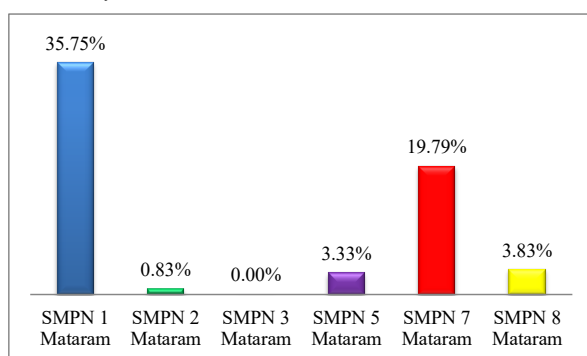


Figure 3. Effectiveness of Learning Tools in Each School

Based on Figure 3, the effectiveness of learning tools in the six schools is in the low to very low category. This happens due to several factors. One of the main factors according to the teacher is the reduction in effective learning hours. Of course this has an impact on the lack of absorption of students in receiving lessons. In addition, according to students, the time given during the learning outcomes test was very short, the narrative of the questions given was long, the questions were done in large numbers, and all questions were in the form of descriptions and based on HOTS. As a result, students cannot work on the test questions to the maximum extent possible. Based on the results of interviews with teachers, in working on LOTS (Lower Order Thinking Skills) questions, students still have difficulty solving them. Of course, completing the test questions in the form of HOTS questions will be even more difficult for them. This causes the low results of the learning outcomes test.

### CONCLUSION

Based on the results of the study, according to the teacher, the Essence of learning tools can help students to achieve Competency Achievement Indicators in the Algebraic Form material. In contrast, the learning outcomes test showed that the learning tools had low effectiveness in encouraging students to achieve the expected competencies in the Algebraic Forms material. This is caused by

various factors such as the pandemic situation which causes a reduction in effective learning hours in schools, resulting in a lack of learning engagement by students.

#### ACKNOWLEDGMENT

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**ACCEPTANCE LETTER**

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## EFFECTIVENESS OF HOTS AND 4C BASED LEARNING TOOLS

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### Abstract

HOTS (Higher Order Thinking Skills)-oriented learning and the integration of 4C (Critical Thinking, Creativity, Collaboration, and Communication) in learning are one of the efforts in preparing the next generation to have skills that are in accordance with the needs in the Industrial 4.0 era. This study aims to measure the effectiveness of HOTS and 4C-based learning tools in helping students achieve basic competencies in Algebraic Form topic. The research was conducted using qualitative and quantitative methods. The research subjects were six students and two teachers of two difference junior high school in Matura City. The results show that the teacher regard that the learning tools help students achieve Competency Achievement Indicators in the Algebraic Form material. Nonetheless the learning outcome test show that learning tools have low effectiveness in encouraging students to achieve the expected competencies in the Algebraic Forms material. The pandemic is the main factor that triggers the later.

**Keywords:** HOTS, 4C, Learning Tools, Industry 4.0, 21st Century Skills

### INTRODUCTION

The development of the use of digital technology seems unavoidable in this era (Jadertrierveiler et al., 2019). The Industrial Era 4.0 is the main reason for the start of massive digitalization in every aspect of life in the 21st century(Sima et al., 2020). Starting from human labor being replaced by machines to the emergence of various new types of work, this is the impact of the Industrial 4.0 era (Gandasari et al., 2020; Memon & Ooi, 2021).

In 2020-2030, Indonesia will enjoy the Demographic Bonus (Wisnumurti et al., 2018). This phenomenon occurs when the number of Indonesian population in productive age (14 – 64 years) is more than the population with unproductive age (less than 14 years or more than 64 years) (Rostiana & Rodesbi, 2020; Warsito, 2019). Of course, this can be an opportunity for Indonesia in an effort to increase national development(Hendratno & Fitriati, 2016; Oey-Gardiner & Gardiner, 2013).

Therefore, it is a challenge for Indonesia in this Industry 4.0 era to be able to take advantage of the Demographic Bonus (Ilyas et al., 2020). Because the Demographic Bonus can also be a threat to Indonesia. One of the threats that lurk is educated unemployment which often occurs due to the skills possessed are not in accordance with what is needed at that time(Gandasari et al., 2020; Memon & Ooi, 2021; Nambiar et al., 2019). So that the provision of the next generation to have the appropriate skills needed in this Industry 4.0 era needs to be done (Ana et al., 2018). HOTS (Higher Order Thinking Skills)-oriented learning and the integration of 21st century skills in learning is one of the efforts in preparing the next generation to have skills that are in accordance with the needs in the Industrial 4.0 era(Tangahu et al., 2021). HOTS-based learning is learning that focuses on supporting and facilitating students' critical thinking skills so that they become problem solvers(Fanani, A., & Kusmaharti, 2014; Firmadani &

Wulansari, 2020). In this era, HOTS-based learning is needed so that the competence of students can follow the development of science and technology so that they have the competencies needed today.(Sudana et al., 2020). The 21st century skills that must be possessed by students today are 4C competencies, namely Critical Thinking, Creativity, Collaboration, and Communication.(Selman & Jaedun, 2020; Suyitno et al., 2021).

So it is the teacher's obligation to prepare and equip students to have 21st century skills through HOTS-based learning(Pratiwi & Mustadi, 2021). However, in reality there are still many teachers who still have not implemented this. Learning is still teacher-centered where students play more of a role as listeners. Whereas learning in the 21st century should shift to student-centered learning(Sumardi et al., 2020). According to one teacher, the reason this happens is that there are still many students who even have difficulty in teacher-centered learning. Especially in learning mathematics, there are still many students who do not understand basic mathematical concepts such as integer or fractional operations(Sridana et al., 2020). In addition, according to one teacher, the average reading interest of students is low, causing them to prefer learning by listening to the teacher's explanations rather than looking for themselves through reading books or other sources. Even so, HOTS-based learning must still be implemented. Apart from its advantages, the 2013 Curriculum has also mandated that HOTS-based learning be used in the teaching and learning process(Yayuk et al., 2019). Students have difficulty because they are not familiar with the learning process. This research is a continuation of previous research on the development of HOTS-based learning tools. The focus of this research is to measure the effectiveness of the tools that have been developed (RPP, LKPD, and teaching materials).

## RESEARCH METHODS

This research is a mix of qualitative and quantitative descriptive methods. Collecting data using test and interview methods. The research subjects were six seventh grade students from six public junior high schools in Mataram City, West Nusa Tenggara. Qualitative data will be processed descriptively. The data in quantitative form will be converted into qualitative descriptive data. Quantitative data will first be processed into percentage form, with the following formula:

$$\text{Percentage (p)} = \frac{\text{score}}{\text{Ideal Score}} \times 100\% \quad (1)$$

The p value was then converted into a qualitative scale with the guidelines in Table 1:

**Table 1: Conversion of Learning Device Effectiveness**

Score (%)	Category
$p > M_i + 1,5 (SD_i)$	Very high
$M_i + 0,5 (SD_i) < p \leq M_i + 1,5 (SD_i)$	Tall
$M_i - 0,5 (SD_i) < p \leq M_i + 0,5 (SD_i)$	Enough
$M_i - 1,5 (SD_i) < p \leq M_i - 0,5 (SD_i)$	Low
$p \leq M_i - 1,5 (SD_i)$	Very low

(Rusydi & Fadhli, 2018)

## RESULTS AND DISCUSSION

### Learning Implementation Plan (RPP)

In the Learning Implementation Plan (RPP), adjustments are made to each activity to improve 21st century skills. The core activities in the RPP are focused on improving 4C competencies. The learning model applied is problem based learning (PBL) which facilitates learning conditions with HOTS-based tools (Firmadani & Wulansari, 2020).

The HOTS-based lesson plans used in this study with the impact of 4C competencies is displayed in Table 2.

**Table 2: Integration of 4C Competencies in RPP**

No.	Core activities	4C Kompetensi Competence
1	The teacher organizes students into 5 heterogeneous groups and students sit based on the groups that have been created.	Collaboration
2	Students understand the procedures for working on HOTS-based worksheets delivered by the teacher.	Collaboration, Communication, Critical
3	Students start working on the worksheets that have been distributed.	Thinking, Creativity
4	The teacher ensures that there is a division of roles in the group.	Collaboration
5	Each group is given the opportunity to seek information from other sources to help solve problems in the HOTS-based LKPD	Collaboration, Communication, Critical
6	The teacher randomly appoints two groups to present the results of their discussion, while the other groups respond.	Thinking, Creativity

Table 2 shows the integration of 4C competencies in core activities in the RPP. Thus, using HOTS-based lesson plans, especially the PBL model, can train all 4C competencies that must be possessed by students. For example in activity number 3, in this activity students will work on LKPD in groups (Collaboration). Of course, discussions between group members will be carried out (Communication). In the process of solving problems in LKPD students will practice their ability to identify, analyze, and evaluate information (critical thinking) or problems and combine various ideas or information into a solution to a given problem (creativity). (R. Kelley et al., 2019; Wiedarti, Pangesti; Laksono et al., 2019).

In addition, the RPP indirectly helps students develop the characters needed to support 21st century skills. In general, there are six characters that can support 21st century skills, namely mindfulness, curiosity, leadership, courage, resilience, and ethics. (Horvathova et al., 2015). However, in terms of character building, Indonesia associates it with Pancasila (Figure 1). So that there are five 21st century characters in Indonesia which became known as Strengthening Character Education, namely religious, national, independent, mutual cooperation, and integrity. (Wiedarti, Pangesti; Laksono et al., 2019).

For example in core activity number 1, making students work in a group can practice the values of Pancasila, namely religious which is reflected in learning to be tolerant and mutual cooperation which is reflected in the attitude of solidarity, mutual help and kinship. Based on the teacher's comments as practitioners, the lesson plans that have been prepared have complied with the rules for making lesson plans that have been suggested by the government. In addition,

the lesson plans can also help increase student activity in the classroom and help guide students' higher-order thinking skills and 21st century skills.

### Student Worksheet

The Student Worksheet developed is a HOTS-based student worksheet that refers to PBL, namely student worksheet using the PBL syntax. In this study, student worksheet will be done in groups by students. Based on previous research, the use of HOTS-based worksheets with a PBL approach can help improve students' higher-order thinking skills, critical thinking skills, creativity, collaboration and communication skills.(Herdiansyah, 2018; Purwasi & Fitriyana, 2020; Risfalidah et al., 2019; Setioso et al., 2016; Sulaiman & Shahrill, 2015; Umriani et al., 2020).

**Table 3: Adaptation of PBL syntax and 4C integration in LKPD**

No.	Student Worksheet Section	Stages	4C Kompetensi Competence
1	<p><b>a. Bentuk Aljabar dan Unsur-unsurnya</b></p> <p>Perhatikan ilustrasi berikut</p> <p>Bentuk Aljabar, Variabel, Konstanta, dan Faktor Seorang anak setiap hari diberikan uang saku yang besarnya tetap, yaitu Rp. 10.000,00. Selain itu setiap akhir pekan, ditambah uang saku akhir pekan sebesar Rp. 35.000,00. Jumlah uang saku yang diterima anak tersebut dalam seminggu adalah <math>70.000 + 35.000 = 105.000</math> rupiah. Jika uang saku tiap hari dimisalkan <math>x</math>, maka jumlah uang saku yang diterima dalam seminggu adalah <math>7x + 35.000</math> Bentuk <math>7x + 35.000</math> ini dikenal dengan bentuk aljabar. Istilah-istilah yang terkait dengan bentuk aljabar <math>7x + 35.000</math> adalah sebagai berikut:</p> <ul style="list-style-type: none"> <li>• <math>x</math> disebut variabel atau peubah</li> <li>• 7 disebut koefisien, yaitu bilangan yang melekat pada variabel</li> <li>• <math>7x + 35.000 = 7(x + 5.000)</math> merupakan perkalian antara 7 dan <math>x + 5.000</math>, atau 1 dan <math>7x + 35.000</math>. Oleh karenanya faktor dari <math>7x + 35.000</math> adalah 1, 7, <math>x+5.000</math>, dan <math>7x+35.000</math></li> <li>• 25.000 disebut konstanta</li> </ul>	Student orientation on the problem	critical thinking
2	<p>Anggota Kelompok :</p> <p>1) _____</p> <p>2) _____</p> <p>3) _____</p> <p>4) _____</p> <p>5) _____</p> <p>Kerjakan soal-soal pada LKPD ini secara berkelompok 4-5 lima orang.</p>	Organizing students to study together in groups	Collaboration

3	<p>Aktivitas</p> <div style="border: 1px solid black; padding: 5px;"> <ol style="list-style-type: none"> <li>1. Lakukan pengamatan di dalam kelas kalian. Catatlah banyak meja, kursi, dan lemari. Meja = ..., kursi = ....., lemari = ....</li> <li>2. Apabila diketahui harga tiap-tiap benda yang diamati adalah sebagai berikut: <ul style="list-style-type: none"> <li>• Harga meja = 2 kali harga kursi</li> <li>• Harga lemari = 5 kali harga kursi</li> </ul> </li> <li>3. Diskusikanlah dalam kelompokmu! Misalkan harga kursi adalah <math>x</math> Tentukan bentuk aljabar dari: <ol style="list-style-type: none"> <li>a. Harga kursi seluruhnya adalah .....</li> <li>b. Harga meja seluruhnya adalah .....</li> <li>c. Harga lemari seluruhnya adalah .....</li> <li>d. Jumlah harga seluruhnya adalah .....</li> </ol> </li> <li>4. Berdasarkan jawaban no 3, lengkapi tabel berikut</li> </ol> <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th>No</th> <th>Bentuk aljabar</th> <th>koefisien</th> <th>variabel</th> <th>faktor</th> </tr> </thead> <tbody> <tr> <td>3a</td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>3b</td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>3c</td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>3d</td> <td></td> <td></td> <td></td> <td></td> </tr> </tbody> </table> </div>	No	Bentuk aljabar	koefisien	variabel	faktor	3a					3b					3c					3d					Guiding group investigation	Creativity, Critical Thinking, Collaboration, Communication
No	Bentuk aljabar	koefisien	variabel	faktor																								
3a																												
3b																												
3c																												
3d																												
4	Develop and present the work																											
5	Analyze and evaluate the problem solving process																											

In Table 3, the PBL learning syntax adapted into the HOTS student worksheet is presented. In problem orientation activities, students are given illustrations related to the concepts being studied. The activity of organizing students is done by dividing students into several groups. In the activity of guiding the investigation, the teacher will direct students to investigate and solve problems. In the activity of developing and presenting the work, students are asked to present the results of their work and discussions with the group. Then the last part is evaluating the problem-solving process, where students are asked to complete evaluation questions.


According to teachers in previous studies, student worksheet has accommodated the literacy and numeracy abilities of students. In addition, according to other teachers' comments, the improved LKPD can also guide students to analyze story questions and improve their ability to solve HOTS-based questions (Sridana, 2020).

In this study, there are also inputs for time allocation, many activities, and questions on the LKPD to be reduced by paying attention to the current situation. Given the reduced effective hours of learning in schools due to the pandemic.

### Teaching materials

Teaching materials are prepared with the local cultural context, namely West Nusa Tenggara. At the beginning of each sub-chapter there will be a problem related to the cultural context. The use of local cultural contexts so that students are more familiarized of their own culture and traditions. In addition, this is also part of participation in supporting literacy activities in schools through cultural literacy, literacy, literacy, and numeracy which are the literacy foundations of 21st century skills.(Sridana, 2020).

In previous research, teaching materials were made to support 21st century skills. In this study, the teaching materials were refined based on HOTS. In the teaching materials, the initial description of each sub-chapter is presented with a problem. Then from these problems, students will be guided to understand the concepts that can be used to solve these problems. In the teaching materials, the evaluation questions presented are HOTS-based questions. The HOTS questions in research are based on the HOTS criteria in the revised Bloom's Taxonomy, namely analyzing, evaluating, and creating.

<p><b>1. MENGENAL BENTUK ALJABAR</b></p> <p>Suatu hari ada acara syukuran di rumah Bara dan Dara. Oleh ibunya, mereka diminta untuk mengantarkan "ares" untuk tetangga di sekitar kompleksnya. Jika banyak "ares" yang diberikan oleh ibu kepada Bara lebih banyak tiga bungkus daripada Dara, maka banyak "ares" yang diberikan ibu kepada Bara adalah?</p> <p>Bagaimana kalian akan menjawab masalah tersebut? Tentu jika banyak <i>ares</i> yang diberikan ibu kepada Dara diketahui dengan jelas, akan sangat mudah untuk menentukan banyak <i>ares</i> yang diberikan kepada Bara. Namun, di soal hanya</p> <div data-bbox="323 779 528 1039" style="border: 1px solid black; padding: 5px;"> <p><b>POJOK BUDAYA</b></p>  <p>Sumber: merahputih.com</p> <p>"Ares" merupakan salah satu masakan khas suku Sasak. Dibuat dari batang pohon pisang yang masih muda. Biasanya disajikan dalam acara - acara besar seperti "begawe" (syukuran)</p> </div>	<p>Yuk kita cari tahu kemungkinan banyak <i>ares</i> yang diberikan kepada Bara dengan mengisi tabel dibawah ini:</p> <table border="1" data-bbox="954 763 1217 958"> <thead> <tr> <th>Banyak <i>ares</i> Dara</th> <th>Banyak <i>ares</i> Bara</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>1 + 3 = 4</td> </tr> <tr> <td>2</td> <td>...</td> </tr> <tr> <td>3</td> <td>...</td> </tr> <tr> <td>4</td> <td>...</td> </tr> <tr> <td>5</td> <td>...</td> </tr> <tr> <td>dst</td> <td>dst</td> </tr> </tbody> </table> <p>Tabel 1.1 Kemungkinan Banyak <i>ares</i> Bara</p> <p>Dapat diamati dari tabel kemungkinan jawabannya sangat banyak, bahkan sampai tak terhingga. Dapatkah kalian menulis semua jawaban yang mungkin? Itulah mengapa dibutuhkan aljabar untuk memudahkan dalam menjawab masalah tersebut. Dalam aljabar, kita dapat menggantikan</p>	Banyak <i>ares</i> Dara	Banyak <i>ares</i> Bara	1	1 + 3 = 4	2	...	3	...	4	...	5	...	dst	dst
Banyak <i>ares</i> Dara	Banyak <i>ares</i> Bara														
1	1 + 3 = 4														
2	...														
3	...														
4	...														
5	...														
dst	dst														
<p><b>Figure 1: Problem Orientation</b></p>	<p><b>Figure 2: Concept Development</b></p>														

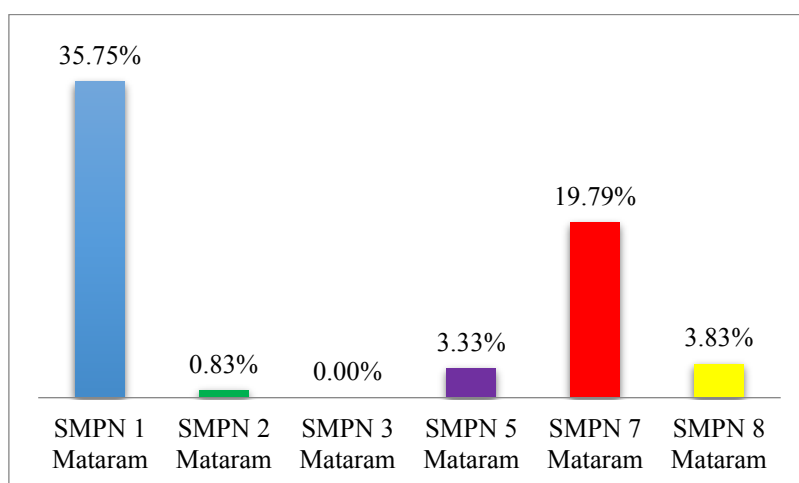
In Figure 1 students are asked to explore the problems given, this is to facilitate students in improving critical thinking competence. Then in Figure 2 students are asked to work on the questions with the understanding they have. Only then at the end of the sub-chapter, they are asked to solve the problems given according to the concepts that have been studied. This is in order to support the critical thinking and creativity competencies of students. In addition, teaching materials are made as detailed as possible so that they can be used independently by students.

According to a teacher's suggestion, teaching materials should be made even more concise, especially in the concept explanation section. This is because some students are more comfortable with concise and dense teaching materials, there is no need for problem narratives and so on, straight to the point. Even though there is a narrative or story that begins each section of the teaching material, it aims to help increase the literacy interest of students. In addition, from the perception of students, the teaching materials they want to use should use contextual problems or the application of mathematics in introducing mathematical concepts. Even so, according to the teacher, the teaching materials developed have been able to help guide students to understand the material in Algebraic Forms and work on student worksheet and evaluation questions.



### Effectiveness of Learning Tools

There are six schools in Mataram City which are sampled in this study. The schools are SMPN 1 Mataram, SMPN 2 Mataram, SMPN 3 Mataram, SMPN 5 Mataram, SMPN 7 Mataram, and SMPN 8 Mataram. The effectiveness of learning tools is obtained from the results of work by students on the learning outcomes test. The effectiveness referred to in this study is the effectiveness of HOTS-based learning tools and integrated 21st century skills in helping students achieve competency achievement indicators in Algebraic Forms material. The effectiveness of learning tools is obtained from the results of learning tests conducted by students.



**Figure 3: Effectiveness of Learning Tools in Each School**

Based on Figure 3, the effectiveness of learning tools in the six schools is in the low to very low category. This happens due to several factors. One of the main factors according to the teacher is the reduction in effective learning hours. Of course this has an impact on the lack of absorption of students in receiving lessons. In addition, according to students, the time given during the learning outcomes test was very short, the narrative of the questions given was long, the questions were done in large numbers, and all questions were in the form of descriptions and based on HOTS. As a result, students cannot work on the test questions to the maximum extent possible. Based on the results of interviews with teachers, in working on LOTS (Lower Order Thinking Skills) questions, students still have difficulty solving them. Of course, completing the test questions in the form of HOTS questions will be even more difficult for them. This causes the low results of the learning outcomes test.

### CONCLUSION

Based on the results of the study, according to the teacher, the Essence of learning tools can help students to achieve Competency Achievement Indicators in the Algebraic Form material. In contrast, the learning outcomes test showed that the learning tools had low effectiveness in encouraging students to achieve the expected competencies in the Algebraic Forms material.

This is caused by various factors such as the pandemic situation which causes a reduction in effective learning hours in schools, resulting in a lack of learning engagement by students.

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