**Regular paper**

# Augmented Reality (AR)-Based Smartphone Application as Student Learning Media for Javanese Wedding Make Up in Central Java

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## Abstract

The purpose of this study was to introduce an application as a learning medium that can be used by students to prepare Solo bridal *paes*. This application can be used by make-up beginners who are learning about Solo bridal *paes*. This study used a quasi-experimental method with a randomized pretest-posttest control group. The *paes* application can be used as a medium in Solo bridal makeup learning, because it is highly effective in helping students prepare Solo bridal *paes*. This application is also considerably practical because it can be installed on smartphones. Experimental results revealed a difference between the control and experimental classes. Students in the experimental class could prepare *paes* neatly, and their shapes were proportional to the face of the model. The use of augmented reality as a medium to teach Solo bridal makeup, especially for making *paes*, is an innovation in the world of education. This application can help students make paes.

**Index Terms**: Augmented reality, Smartphone application, Learning media, Javanese wedding make up

## I. INTRODUCTION

Education can establish a framework for workforce competency. One effort to improve human resources from an educational perspective is through vocational education. Vocational education refers to education for work [1]; thus, vocational education aims to prepare students to work either formally or informally, which implies that vocational education is successful if the graduates are competent and move into a profession. Vocational education can provide benefits to the industry, especially in terms of providing labor [2]. Beauty education is a vocational study program provided at the tertiary level. To face the challenges associated with technological developments in the digital era, beauty education programs must be studied and practiced to produce com-

petent graduates to meet the demands of the developing working world. This technological development can be used as an innovative learning tool in the field of education. Currently, however, there are no digital learning media that enable beauty academy students to easily prepare Solo bridal *paes*.

*Paes* is one of the main parts of the Solo bridal makeup, and it has philosophical significance. The process of making paes is complicated and requires special skills that require quite a lot of training [3]. Moreover, the process of making *paes* must involve "taste;" it is not based on observation, so the makeup results are more interesting. In Java, Rasa is used to cover a mass of material that the speaker does not wish to address and marks a cultural strategy of drawing a line of inquiry to an end [4]. To achieve this, augmented

reality (AR) technology can be utilized. The results of previous research stated that (1) AR learning media was able to improve students' understanding of learning materials (Chiang, Yang and Hwang, 2016); (2) using AR in learning can increase students' motivation [5-7]; (3) AR can increase students' attention during the learning process [8]; (4) AR technology provides opportunities to make learning experiences more interesting and attractive [6]; (5) AR is very useful for the learning process itself [7]; (6) AR is cost-effective, reliable, and very accurate [9]; and (7) the reported average face detection accuracy is 89.0% and the processing time is approximately 5.56 s [10]. Based on some research results, it can be said that using AR as a learning medium can increase students' competence and is very useful for the learning process.

Thus, there are several reasons for researchers to choose AR as a learning media for *paes*, i.e., (1) current beauty education study program students are generation Z, who are very proficient in using technology and require a learning media that matches their characteristics; (2) there are few students who use "*Roso*" in making *paes*; and (3) helping students to study independently, without always requiring supervision by a lecturer.

AR requires hardware that is used to capture images of either 2D or 3D objects. Afterward, this augmentation will be processed using an EOS (Electro Optical System), Android, or other platform-based software. The results of the software processing must be visually displayed on either the monitor/screen or print out. This research requires augmentation in the form of a photo of the model's face, and the final result of this learning media is the *paes*, which corresponds with the size of the model's face and can be printed. At this time, a device/smartphone already has three main components; hence, the use of a smartphone is the most efficient and practical choice to support AR implementation. From the research results, the level of smartphone usage among students was very high, at 94.8% [11]. For students, the use of smartphones is not limited to social media. Currently, smartphones are active learning media that are acceptable to students [12]. Nowadays, digital AR technology can be installed on all smartphone brands. The use of AR as a learning medium and smartphones as a tool helps in the learning process. AR installed in smartphones has several advantages, such as accurately detecting faces, increasing student understanding, and being very practical because it is easy to carry anywhere. Similarly, smartphones are affordable and easy to operate.

AR-based *pae* learning media produces a synthesis display in the form of a *pae* pattern that allows students to easily make *paes*. The use of technological literacy in makeup allows students to achieve appropriate competence. This application provides students with a real simulation and, thus, lecturers only monitor the results of their work. For this

reason, digital technology must be more widely used, especially in the field of makeup learning.

## II. LITERATURE REVIEW

### A. Augmented Reality (AR)-Based Paes Learning Media

In the teaching and learning process, the use of learning media plays an important role because it can affect students' learning achievements. Determining a learning method will impact the type of learning media used, objectives, materials, and evaluation. The use of learning media affects students because they can more easily digest and understand a material. In line with the development of technology, the forms of learning media are also increasingly varied. An educator must always innovate to take advantage of technology in learning activities [13].

The use of technology-based media is very popular among young people. The intensity of the use of interactive learning media is used as a social and cultural space [14]. Therefore, it is appropriate for the world of education to increase the amount of technology-based learning media. This is also supported by several research results on the use of technology-based learning media. Learning using digital technology-based media for students can increase their initiative in learning, analyzing, synthesizing, evaluating, and higher thinking skills, such as critical thinking and problem-solving [15-17]. In addition, the research results of Mayer and Juliana, et al. stated that the use of technology as a learning media is related and very significant to the language, affective, motivation, and cognitive skills of students [18, 19].

Based on the results of these studies, educators are expected to make use of technology-based learning media. One technology that can be used as a learning medium is a smartphone, which is considered more interactive than passive media [20]. Currently, smartphones are not luxury goods. Smartphones are a means of communication and mostly use Android as the operating system. Android is a Linux-based mobile device operating system that provides an open platform for developers to create applications [21, 22].

In this study, smartphones were used as the hardware to support AR-based learning media for learning devices. The majority of both educators and students have smartphones equipped with cameras [11, 23]. The requirements for a smartphone that can use AR support include a camera, an Android platform, and an EOS.

AR is widely used in education. However, based on several previous research results, there has never been any use of AR, especially as a learning medium that can help students make Solo bridal *paes*. *Paes* go is a processing software based on AR technology that assists students in making
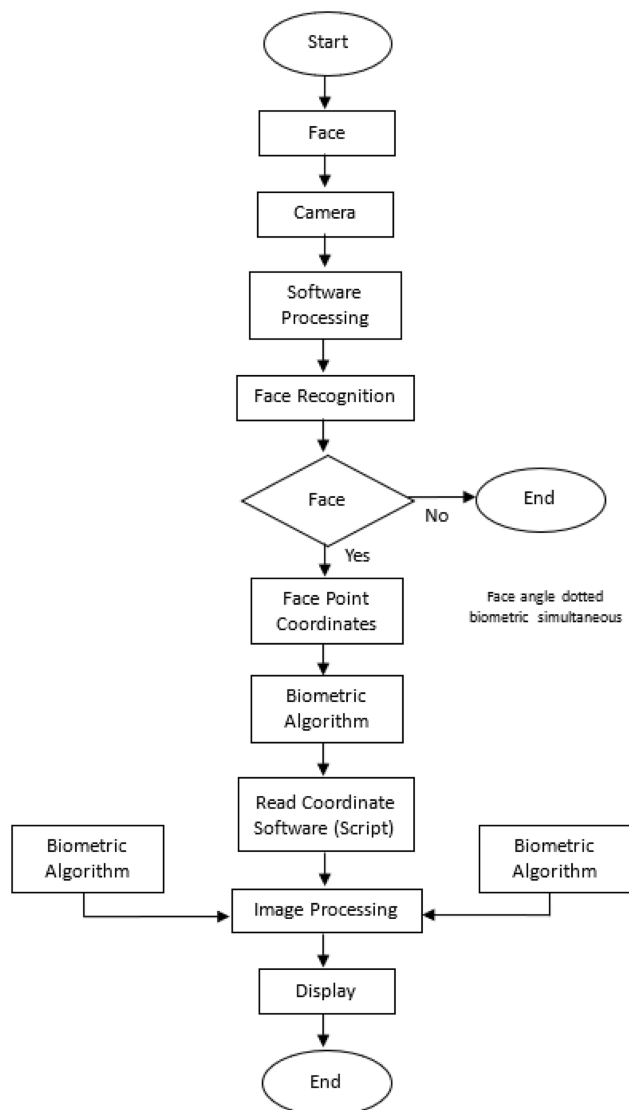
**Fig. 1.** *Paes* application program design.

Solo bridal *paes*. This application uses biometric face recognition as a system to identify similar faces by using a smartphone as a display tool. The design of a facial recognition system application to create a *paste* pattern combines two methods, namely augmented reality and programming with a special algorithm to select a *pae* with a size that matches the model's face. Face-based data were calculated using the golden ratio. The golden ratio is a mathematical ratio with special and significant characteristics in the aesthetic field [24]. The calculation of the face ratio in this study refers to the research results of Karem et al. and Peter M. Prendergast. Karem and Peter used facial anatomy and proportion to analyze facial ratios [25, 26].
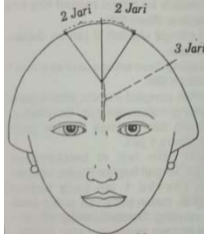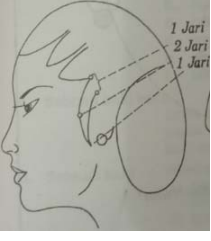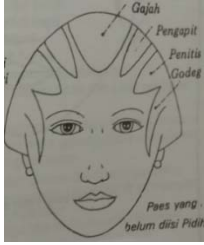
### B. Solo Bridal Makeup

Makeup is a sub-category of art, which is the art of bridal makeup or the art of *paes*. All traditional make-up, clothing, and ceremonies have artistic value or prioritize aesthetics. Solo bridal makeup has aesthetic value because of its aesthetic characteristics. According to Beardsley [27], aesthetic value has the following characteristics: (1) unity, i.e., the object has a perfect shape, is well organized, and has a harmony of forms; (2) complexity, i.e., the objects are rich in contrasts, such as contrasting colors; (3) seriousness (intensity), i.e., the object exhibits a good quality and is intensive and symbolic.

Liang Gie [28] argues that the general characteristics of an aesthetic object are unity, harmony, coverage, balance, and resistance/contrast. In general, the greater the unity, complexity, and intensity of an object, the greater its aesthetic value [29]. All parts of the Solo make-up and bridal dress have harmony. The harmony in Solo bridal makeup, for example, is the combination of leaves and flowers, clothes, and accessories worn by the bride. An example of the symmetry (*kesetangkupan*) element in the Solo bridal makeup is *paes*. *Setangkup* means a pair. Solo bridal *paes* comprises elephants, clamps, droppers, and *sideboards*, where the right and left sides must be symmetrical. This demonstrates balance. The combination of striking colors and materials used in the Solo Bride has contrasting characteristics. For example, the combination of red and green in a Solo wedding dress with a basahan style. Overall, bridal makeup is a unit that cannot be separated. Therefore, these elements are made separately, with various shapes and colors that meet the elements of complexity and seriousness as a symbol of human life.

### C. Solo Bridal Paes

*Paes* is one of the main parts of the Solo bridal makeup. Aside from having philosophical meaning, the process of making *paes* is quite complicated and requires special skills that must be heavily trained [3]. The results of the *pae* painting applied to the bride's face must look harmonious, proportionate, neat, and clean [30]. Before making *paes*, you must first prepare the *pae* pattern, often referred to as *cengkorongan*. The Solo bridal *paes cengkorongan* consists of four parts, namely elephant, clamp, dropper, and *sideboards*, with a ratio of 4: 2: 2(1/2): 1 with the tip of the *paes* pointing towards the middle of the woman's nose [3, 31, 32]. Solo bridal *paes* use a black *pidih*, except for the *basahan* pattern, which uses a green *pidih*. *Paes* has a standard form that is not modifiable.

**Table 1.** Preparing *Paes* via Traditional Methods

| Techniques | Solo *Puteri* Bride |
|---|---|
| **Elephant:**<br>a) Measure 3 fingers from the base of the eyebrows to the top, make a point<br>b) From the point, draw a straight line to the top<br>c) From the line, measure ± 2 fingers to the left and right. The total is 4 fingers, thus there are 3 dots<br>d) Connect these three points, make a curved line that resembles a half-circle like the tip of a duck egg. | |
| **Clamp:**<br>a) From the base of the elephant, measure two fingers each for left and right, then draw a point,<br>b) From this point, measure again ± 2.5 fingers left and right, draw a point;<br>c) Back to the tip of the elephant, measure ± 4 fingers to the left and right each, then draw a point. Make sure that this point is located approximately 1 thumb above the eyebrows;<br>d) Therefore, there are 3 more points. The three points are connected with a line that appears as a half-circle, similar to the tip of a chicken egg. | |
| **Dropper:**<br>a) Determine the midline between the base of elephant and dropper, draw a point;<br>b) Draw a midline then a point between the tip elephant and dropper, draw a straight line;<br>c) Give a space of ± 0.5 cm between the base elephant and dropper, then draw a point;<br>d) Therefore, three points are connected. Draw a line that resembles a flower bud (*ngudup kantil*). The end of the clamp should lead to the base of the eyebrows. | |
| **Sideboards:**<br>a) From the base of the dropper, the line is continued into the hair approximately 1 cm, then a point is drawn;<br>b) From the ear measure forward 2 fingers given a point; b) Measure using 2 fingers from the ear, then draw a point;<br>c) From the tip of the ear, measure ± 1 finger, draw a point;<br>d) From the starting point of the dropper, draw a curved line through the two points, and towards the tip of the earlobe between 1 finger;<br>e) Make a point from the base of the upper ear with a distance of 1 finger. Make a point in the middle of the front ear with a distance of 1 finger. Connect the two points with a curved line. | |
| *Cengkorongan* result | |

## III. METHODS

### A. Respondent

The respondents were 70 female students taking the Javanese bridal makeup course in the beauty education study program. The average age of the respondents was 20, they each had a smartphone and could operate the application and did not have experience in making Solo bridal *paes*. The sample size was determined using the reference sample size of Isaac and Michael [33], with an error rate of 1%. This study was conducted from March to November of 2020.

### B. Stimuli and apparatus

Participants are asked to download the Paes application from viahttps://play.google.com/store/apps/details?id=com.pura.my*paes*go using their respective smartphones. Then, the participants start the *Paes* application and point it at the model's face until the pattern appears. This application can create a *paste* pattern according to the face captured by the camera. To print out a *pae* pattern, press the print button. By pressing the print button, the *pae* pattern is saved in the user's email as a PDF file. The method used and the results of the printed
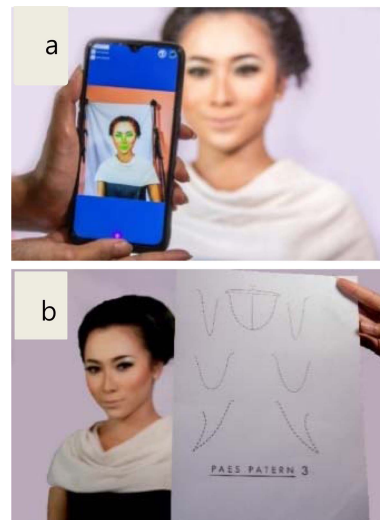


**Fig. 2.** Printed *paes* pattern.



**Fig. 3.** *Paes* pattern after cutting .

*paes* pattern are shown in Fig. 2.

Fig. 2 shows how to use the *paes* application and the result of the paste pattern before they are cut. (a) Point the camera at the face of the model. The *pae* pattern automatically appears when the camera captures the face. (b) The pattern result is printed by pressing the print button that links to the email. The printouts of the *paes* that match the face of the model can be printed, cut-out, and used as a pattern on the model's face. Mistakes in cutting can affect the size of the *pae*. The printing of the cut *paes* is shown in Fig. 3. The *pae* patterns produced are different for each person, according to the size of the face and forehead.

### 1) Drawing Cengkorongan Using the Paes Application

A cut-out *pae* pattern was attached to the forehead. This process is performed gradually, starting with elephants, clamps, *droppers*, and sideboards. Next, we used an eyebrow pencil to draw, according to the *cengkorongan* size. To be proportional, each part of the base of the *paes* must meet/unite; thus, the paes automatically fall right in the middle of the nose bridge. The process of making *a cengkorongan* is illustrated in Fig. 3.

Fig. 4 shows the process of making Solo-Bridal *Paes* using the *Paes* application. The printout result from the *pae* application is cut and then attached to the forehead of the model. This setting aims to lead the *paes* to fall right in the middle of the model's nose and the length of the *paes* matches the model's face. (a) The first part of the *pae* made is an elephant. The elephant is in the form of ½ round duck egg tip, located in the middle of the forehead, above the base of the eyebrows between ± three fingers above the eyebrows (b) making of *paes* dropper. The dropper is in the shape of a ½ round like the chicken egg tip. The dropper tip faces the corner/top of the eyebrow (c) continue making a clamp. The clamp is in the form of *ngudup kantil* (*kantil flower buds*), located on the right and left of the elephant. The tip faces the base of the eyebrows and (d) the last part, which is making sideboards. Sideboards are in the form of "*ngudup turi*' (*turi flower buds*).



**Fig. 4.** Process of making *cengkorongan*.



**Fig. 5.** *Paes* pattern results.

Fig. 5 shows the *pae* pattern results before cosmetic application, that is, (a) *pae* results using the app. (b) *Pae* of the Solo bride after black color drawing using "*pidih*" cosmetics.

This study used a quasi-experimental method with a randomized pretest-posttest control group design [38].

| | | | | |
|---|---|---|---|---|
| Experimental Group | R | $Y_1$ | X | $Y_2$ |
| Control Group | R | $Y_1$ | - | $Y_2$ |

Description:

X = The making of Solo bridal *paes* using *paes* application

- = The making of Solo bridal *paes* using conventional techniques.

This study was divided into two classes: control and experimental. The selection of control and experimental classes was conducted randomly, with each class consisting of 35 people. Data were collected using Solo Bride *Paes* assessment sheets. The assessment sheet used was used to assess the Solo bridal makeup competency test.

### C. Data Analysis

Data analysis was performed using the percentage technique for product validity and to see the difference in the results of *pae-making* between the post-test and pre-test scores. The product in this research was the *PES* face recognition application. Before the trial, this application was validated by three experts in learning media and one expert in bridal makeup. To test the validity of the *Paes* application, the validator is given a questionnaire in which each statement has a value of 1 to 4. The score has the following criteria: (1) not proper/not good, (2) less proper/less good, (3) proper/good, and (4) very good or very good. Subsequently, a percentage was calculated based on the results of the model validity. The percentage was calculated from the score of each item and the total validation score. The product validity test was conducted using the Delphi technique, which involves observing the consensus of experts on validation aspects. The experts' consensus was reflected by the evaluation score of the validation aspects. To determine the consensus level of the experts, a score calculation was used on the validation components using the following formula:

**Table 2.** Eligibility categories for *paes* face recognition application

| Scale | Category |
|---|---|
| 80% s.d. 100% | Very Proper |
| 66% s.d. 79% | Proper |
| 56% s.d. 65% | Less Proper |
| 0% s.d. 55% | Not Proper |

$$P = \frac{(n_1 \times 1) + (n_2 \times 2) + (n_3 \times 3) + (n_4 \times 4)}{N \times 4} \times 100\%$$

Description:
P  = percentage of answers
$n_{1-4}$ = option for score
N  = total questionnaire items

Based on the percentage calculation results, confirmation was made using the validity criteria. The validity criteria used in this study are presented in Table 3.

After the validity test, application testing was conducted. Application testing is performed by examining the score of students' practice in making *paes*. This value will be compared descriptively between the control and experimental classes. The practice of making *paes* in the control class was conducted using techniques that had been taught so far while, in the experimental class, students were given applications to help make *paes*. The test was conducted in separate rooms at the same hour and using the same class facility. Each class comprised 35 students.

## IV. RESULT

### A. Media Experts Validation Results of Against Paes Application

The media expert validation aims to measure the feasibility of the media to be developed, where the input will be used as a reference for improving the media (revision) before taking the next step, which is called product testing. The results of media expert validation on the development of Paes Go are shown in Fig 6.
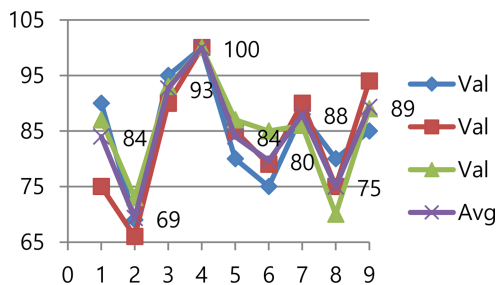


**Fig. 6.** Scores of the media expert's assessment analysis of the Paes application.

The results of the media expert's assessment analysis of the *Paes* application are as follows:

1. The conformity of the media with the *paste* material is displayed. On average, the media expert validators responded that the result was very good, with a percentage of 84%. The shape and size of the *paes* produced by the application matched predetermined sizes. The Solo bride *paes* had several sections of different shapes and sizes. The shape and size of the *paes* that had been pressed consisted of (1) elephant, in the shape of ½ round of the tip of a duck egg, located in the middle of the forehead, above the base of the eyebrows ± three fingers above the eyebrows with a size of ± 4 fingers; (2) clamp, in the form of *ngudup kantil* (*kantil* flower buds), located on the right and left of the elephant. The tip faces the base of the eyebrow with a size of ± 2 fingers; (3) dropper, in the shape of ½ circle of chicken egg tip. The tip of the dropper faces the corner/top of the eyebrow with a size of ± 2.5, and (4) sideboards, in the form of a *ngudup turi* (*turi* flower bud) with a size of one finger.

2. On average, the validators responded that the display of the paes application was appropriate, with a percentage of 69%. The *paes* application display tended to be dark; therefore, it was necessary to add more contrasting colors in some parts to make it more attractive. Even though it was dark, the pattern of the *paes* shown on the smartphone's screen was clear because it used red.

3. Regarding the ease of application use, 95% of the validators mentioned that it was very proper. The *Paes* application was very easy to use because students need to simply scan the smartphone camera against the model's face so that the pattern appeared on the smartphone screen.

4. Regarding *pae* application convenience, 100% of validators responded that it was very appropriate. The *Paes* application was very easy to carry everywhere and flexible because this application was installed on a smartphone. The size of this application was 42 MB; thus, it did not burden the smartphone's performance.

5. The completeness of the *paes* application composition was responded as very proper, with a percentage of 84%. The composition of the *paes* application was said to be very complete because this application was equipped with a user guide button, an e-book of Solo bridal make-up, a "save" button to save the result without being connected to the email, so it was more practical to print. The *pae* patterns were very complete, consisting of elephants, clamps, droppers, and sideboards.

6. The conformity result of the *paes* using this application was very good, with a percentage of 84%. This application produced *paes* that were proportional to the model's face. To make proportional *paes,* students must be able to

cut the *pae* pattern right at the outer line, attach the *paes* pattern correctly on the forehead in the hairline, and ensure that the ends of the *paes* must unite with one another. The size of each part of the *paes* produced by this application was adjusted to the proportions of the model's face so that when compared to manual measuring, there was a slight difference of approximately 0.5-1 millimeter for each part.

7. The level of need for *pae* applications has an average score of 88%, which is very appropriate. This was because this application was needed, especially for students who were learning to make Solo bridal *paes*. This application made pae-making, which was previously difficult to be easier and more enjoyable, especially for students who were just learning *paes*.

8. The downloading of the *paes* application was easy, with a score of 75%, which was categorized as proper. This application was very easy to download. Some types of smartphones require longer steps, and thus, it seems complicated. In addition, the Internet connection strength significantly affected the download speed.

9. The time needed to make *paes* was answered as very appropriate by 89% of the respondents. Making *paes* using this application could be done in 15 minutes, which was faster than manual techniques, especially for students who were still learning about *paes*.

### B. Paes Application Testing Data

To determine if this application can be used to ease *pae-making*, a trial was conducted on 70 students, grouped into a control class and experimental class. The results of the assessment included the *pae* forms, which consisted of elephants, droppers, clamps, sideboards, time, and tidiness.
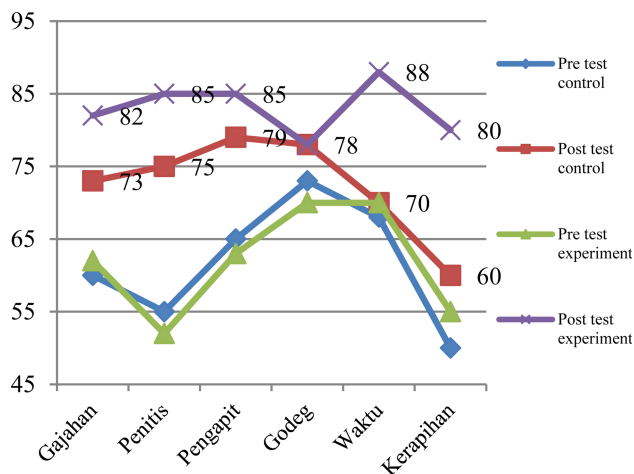


**Fig. 6.** Scores of solo bride p*aes*.

## V. DISCUSSION

The use of the *Paes* application learning media significantly facilitates beauty education students in making *paes*. The *pae* application is very easy to use and effective because it is embedded on a smartphone screen. The resulting pae patterns are very proportional and can be applied to various facial shapes. The process takes a short time — i.e., approximately 15 min — and the of the *paes* falls right in the middle of the nose. In addition, the *paes* result looks tidier. By using this application, students can train "roso" in making *paes* and so will more quickly understand how to make good and correct *paes*.

The use of *the Paes* application provides an experience for students that making *paes* is not difficult. With this application, making *paes* becomes easier and more enjoyable, thus providing students with a particular experience. Based on this experience, they can continue to learn and analyze, and then try again. Learning is a process of transforming knowledge through experience [34]. The experience of making *paes* is very meaningful to novice makeup artists as it can spur their excitement. Real experiences are used as a reference that can stimulate emotion to increase their motivation to always learn and try [35], [36]. Makeup beginners are more likely they are to succeed in their studies if they have a greater motivation to learn [36], [37]. Paes-learning media significantly helps students to make one. Practically, there are still some challenges in this media that affect the results of Solo bridal *paes*. Among others, the challenges include: students had difficulty in cutting the *pae* pattern; the *paes* had to be properly placed on the forehead, which was on the hairline; and the top of the *paes* had to stick together. Furthermore, the eyebrow pencil used must be sharp. With these challenges, it is hoped that further research will be conducted to improve this learning media.

### Acknowledgments

the world of education. By using the application, students can make paes easier so that it can motivate them to do Solo bridal makeup.

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