The Development of Video on Pickled Fruit Production for Flipped Classroom*

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Andian Ari Anggraeni(✉), Sumaryana, Wika Rinawati, Dewi Eka Murniati
Universitas Negeri Yogyakarta, Yogyakarta, Indonesia
andian_ari@uny.ac.id

Abstract—Undergraduate students are categorized as Generation Z. They prefer learning using video rather than the book. Demonstration videos are suitable for productive courses because they show step by step of product making. This study aimed to 1) develop a video of pickled fruit production for the Food Preservation Technology course, Universitas Negeri Yogyakarta (UNY), Indonesia and 2) determine the video's feasibility. This study was a research and development (R&D) performed by ten steps, namely information collecting, planning, developing initial products, preliminary field testing, main product revision, main field testing, operational product revision, operational field testing, final product revision, as well as dissemination and implementation. Data analysis was performed descriptively. The video feasibility analysis was conducted by one material expert, one media expert, two teachers, two peer reviewers, four students in one-on-one testing, and 36 students in classroom testing. Based on the feasibility test, the video was declared very feasible as learning media. Text, images, animations, and effects appeared in several parts of the video, making it easier for the students to understand the content. This video can be embedded in the learning management system (LMS) such as Google Classroom, Moodle, and others to facilitate mobile learning, and implemented in a flipped classroom design. Pre-test and post-test were then performed on 29 students in operational field testing. The post-test was significantly higher than the pre-test ($p<0.05$), so the video was able to improve the students' cognitive skills.

Keywords—m-learning, multimedia learning, demonstration video, food science learning, food science education

1 Introduction

Generation Z grow up with increasingly cutting-edge information and communication technology (ICT). It makes them proficient in utilizing technology such as computers, laptops, and various software applications, for their daily activities [1]. They can easily and quickly access any required information and prefer digital interaction

* The authors hereby confirm that they have obtained the consent of the persons depicted in the photographs for publication.

through social media, for instance, YouTube, Instagram, Line, WhatsApp, Twitter, and others [1]. They can do all activities through the digital world anytime [2] and perform various activities simultaneously [1]. They enjoy technology-based learning because it supports mobile learning [1]. Common digital media for mobile learning are included, 1) text with pdf format, 2) audio such as podcast, 3) video namely podcast video, demonstration video, animation video, and others, and 4) combination of those media delivered in flipped book or online article [3]. Unlimited access to teaching and learning is the main characteristic of the education 4.0 era.

Education 4.0 offers innovation and promoting technology in the teaching and learning process [4]. The development of educational technology affects the variety of media used by teachers. Physical books were converted into electronic books or flipped books. Teacher explanation can be recorded and distributed using podcast audio or video. Abstract concept can be made easier to understand using animation videos. Besides, the expensive and/or dangerous environment can be emerged in virtual reality.

Video has gained its popularity for many years. It was started with television based learning and instruction in 1975 [5]. Since the last decade, video was used to support mobile learning. The video could be accessed individually, anytime and anywhere [1]. Video was used to support flipped classroom learning especially for undergraduate students [6]. University students begin learning by doing self-directed asynchronous meetings by observing various videos on LMS. The students then come to class to perform some student-centered activities. Although many positive results have been reported on developing and implementing video in flipped classroom in medical and health education [7], [8], none reported those in the field of food science and technology education.

The productive subjects require demonstration videos during the learning process because those videos show product-making steps [9]. Food Preservation Technology is a psychomotor-skill course in the Culinary Science study program, UNY, Indonesia. The course was delivered using flipped classroom. In the asynchronous meeting facilitated by LMS, the students could access text media, demonstration videos, and quiz [10]. The students' activity to access the learning resources and take the quiz was expected to enhance students' readiness in the laboratory meeting. Students receiving the minimum quiz grade of 70 were allowed to join the laboratory synchronous meeting to perform product making. The learning design in synchronous meetings was carried out using a team problem-based learning where the lecturers acted as facilitators.

Various videos for Food Preservation Technology course have been developed, including the making of soybean juice, vegetable noodles, fried nuts, garlic snack [11], purple sweet potato flour, shredded chicken [12], sorbet [13], and dry banana [14]. However, the demonstration videos for fruit processing are still limited. Fruit processing topic contains processing and preserving fruit into various processed products, such as jams, *dodol* (sweet toffee-like confection), chips, syrup, juice, sorbet, pickled fruits, and others. The pickled fruits can be produced quickly, but attention should be paid to the critical points in selecting fruit raw materials, preventing enzymatic browning reactions, sugar concentrations, drying process, and packaging [15].

Many videos on pickled fruit making have been available on YouTube. Some of these videos have good visual quality, however they have monotonous backgrounds.

Most videos are recorded at one location using limited camera angles. Mostly, those videos are demonstration videos that do not contain introductory material. Critical steps in the production process are also not discussed in those videos, so that those videos do not meet the criteria of good learning videos. Few findings reported the implementation of those videos to support flipped classrooms.

Therefore, the development of learning videos for making pickled fruit was necessary. This article describes the development and the feasibility of a learning video to make pickled fruits for the Food Preservation Technology course. The video is a demonstration video, applying several styles, such as visually annotated and guided by voice recording in the demonstration scenes [16]. The video's effectiveness was then measured by performing pre-test and post-test to evaluate students' cognitive skills and readiness to perform the practical session in the laboratory.

2 Literature review

The characteristics of mobile learning are following the concept of education 4.0; namely, learning can be done individually and not limited by time and space. Mobile learning can be accessed using mobile gadgets such as laptops or cellphones, with the support of an internet connection [17]. Learning media for mobile learning should be designed with digital concepts, have good audio and visual quality. The video for mobile learning should be as shorter as 10-15 minutes [18], [19].

Video is an audio-visual media. Activating the sense of sight and hearing can enhance the learning process and improve the ability to retain information for a more extended period [20]. The use of video as a learning tool has proved to be very useful in influencing the learning process in mass, group, and individual settings. Videos can also be integrated into the LMS for blended learning, online learning [21], and flipped classroom [16]. The video used in online and blended learning has been previously reported in the field of medical and health science education [16], [21]–[23].

Learning videos have several characteristics, i.e., message clarity, independent aspect, user friendly, content representation, visualization with other media (text, graphics, audio), and high-resolution quality [18]. However, videos are lack of interactivity and contain passive content [3]. Because of that, video usage should be complemented with other student-centre activities, such as problem-based [24] or project-based learning [25].

The short duration videos usually gain more views because long video will reduce student's engagement [19]. When the learning videos are related to the test, the students can watch the video repeatedly while completing the test. Several (3–10) simple questions in the quiz kept students' attention in the video and not frustated them [25]. Thus, both strategies increase the student's views. The highly viewed videos are also often guided by presenters who look smart and friendly, and also speak enthusiastically. Those videos usually look sophisticated, high-quality audio, professional, and visually attractive. Generally, those videos need to be supported by a well-established script and created by a qualified production team [26].

Videos cannot be easily modified once they are produced. Developing a ten-minutes video can take 5-20 hours depending on the script accuracy, b-rolls handling, and the

complexity of sound and visual effects. With the urgency of video as learning media, universities need to invest funds, time, and effort for video development [26].

Many articles have described the criteria of learning media that are favored by Generation Z, such as technologically advanced, visually attractive, individualized, quick accessed, and engaging [1], [2], [21]. This article describes the process of developing a learning video that is in line with the preference of Generation Z. Some reports have discussed the style of the demonstration videos, i.e., showing presenter in the narrative section [27] but avoiding presenter's presence in the demonstration scene [16]. Those videos were visually annotated to ease student's understanding [16], [21], guided by voice recording from a real female speaker [28], and used command form for action step [28].

Fig. 1. The research method based on Borg and Gal model [30]

3 Methods

3.1 Research type

This study could be categorized as Research and Development (R&D). This kind of research aimed at producing certain products and testing the effectiveness of the developed products [29]. The approach employed the Borg and Gal model [30]. It consisted of 10 stages, namely information collecting, planning, developing initial products, preliminary field testing, main product revision, main field testing, operational product

revision, operational field testing, final product revision, as well as dissemination and implementation [30]. Figure 1 shows the research procedure in each stage.

3.2 Data and instrument

The data were obtained from observation, feasibility tests, pre-test, and post-test. The observation was used during the information collecting stage. The feasibility test was in the form of a closed and open questionnaire. The closed questionnaire used a Likert scale of 1–4 (very unfeasible, unfeasible, feasible, and very feasible). The 30-item questionnaire for material experts and teachers covered the aspects of learning, material, benefits, and usage. The questionnaire for media expert and peer reviewers contained 33 items covering the aspects of media, benefits, and usage. The questionnaire for students consisted of 30 questions to assess the elements of learning, media, material, benefits, and usage. The open questionnaire was used to express feedback and suggestions about the video. The feasibility test instrument can be accessed in the supplementary file.

The pre-test and post-test were distributed before and after they watch the video, respectively. The test consisted of 18 multiple-choice questions to measure students' cognitive abilities and readiness in carrying out practical activities, as described by the previous study in health education [8]. Cognitive ability was measured from items about fruit theory, preservation techniques, processed fruit products, raw material selection, and packaging theory. The readiness of students to carry out practical activities was measured by items about equipment preparation, material preparation, manufacturing procedures, packaging procedures, and expired date evaluation procedures. The pre-test or post-test can be accessed in the supplementary file.

3.3 Data analysis technique

The feasibility data were analyzed descriptively. The feasibility percentage was calculated using (1).

$$\text{feasibility percentage} = \frac{\text{total score}}{\text{total of maximum score}} \times 100\% \quad (1)$$

The feasibility percentage was then interpreted qualitatively using data conversion from interval scale to ordinal scale, as shown in Table 1 [29]. The video could be used as the learning media if the video was categorized as very feasible.

Table 1. Interval scale data conversion to the ordinal scale

Feasibility Percentage Range (Interval Scale)	Category (Ordinal scale)
0%–25%	Very unfeasible
>25%–50%	Unfeasible
>50%–75%	Feasible
>75%–100%	Very feasible

The pre-test and post-test were analyzed descriptively. The difference between pre-test and post-test was evaluated using t-test analysis.

4 Result and discussion

4.1 Information collecting

The observations and interviews to the students registered in Food Preservation Technology course were carried out by researchers. The lecturers had already used demonstration videos in their learning process. The videos were embedded in the Moodle LMS owned by UNY to support the flipped classroom. The teaching and learning in UNY was supported with Eduroam wifi connection, LCD projectors in all classes and laboratories, and a Moodle-based LMS that supports blended learning.

The students did not like reading, and they preferred digital audio-visual platforms [2]. The textbooks were less attractive and caused boredom to the students. Because of that, the video of pickled fruit making was necessary to provide the learning process preferred by the students. There were few videos on pickled fruit making. However, those videos did not contain introduction material and explanation on critical process steps, used background that interfered with audience's focus (Figure 2 left), recorded with unsuitable camera angle (Figure 2 center), and used text annotation that interfered with the main image (Figure 2 right).

Fig. 2. The previously developed video on pickled fruit making

The video of pickled fruit making needs to be developed to support the learning process. The content of the video included wet pickled salak and dry pickled mango. These two fruits were selected due to their abundant sources. Salak and mango prices decreased during the harvest period. The large stocks at harvest time need to be processed into marketable products with longer shelf life.

4.2 Planning

The planning stage began with preparing video content by testing the wet pickled salak and dry pickled mango recipe to obtain high-quality picked products. Three types of treatments were carried out to prevent enzymatic browning in salak: 1) immersion in saltwater, 2) immersion in sodium bisulfite solution [31], and 3) blanching for 20 seconds [32] and followed by soaking in citric acid solution [33]. The first and second treatments resulted in brownish salak color. The third treatment was successful in maintaining its original color. Two types of treatment were performed to obtain a chewy mango, namely: 1) soaking the mango in sugar solution overnight, and

2) boiling. The first treatment resulted in created hard texture, and the second treatment resulted in a chewy texture.

The next step was the script preparation as the guidelines for making videos. The tabular video script consisted of scene number, take number, duration, visual source, visual insertion, narration, location, and description. The duration column was used to estimate the total video duration. The desired video duration ranged from 10–15 minutes, because the video duration was related to users' ability to recall and focus [18]. The narration text was adopted from academic literature, such as journal articles and books. However, narrative writing must be carefully considered to change the writing language into standard verbal communication [7]. The difficulty in scriptwriting was that the vocabulary used should be understandable and straightforward. Moreover, the demonstration scenes must be performed sequentially to avoid flashback scenes.

The visual insertion column in the script would guide the video editing process. This column contained text, image, and animation insertion. Text and image were used to clarify the content delivered by the presenter. The text must be short of making the audience more comfortable to absorb the information [34] because long texts can interrupt students' focus. Meanwhile, animations were added through content visualization to improve student understanding.

The script was then analyzed by the material and media experts. The material experts evaluated the content accuracy, while the media experts reviewed the language styles, flashback sentences, and flashback scenes. The revision was carried out six times according to both experts' suggestions until the script was declared feasible. The script was carefully written according to learning objectives to minimize mistakes in video recording and save energy, time, and fund.

The formation of the production team was based on the expertise, production skills, instructional design experience, and managerial skills on video projects [22]. The presenter selection was based on the ability to make eye contact with the camera and explain the content in-camera, facial expressions, and body language. The presenter's articulation should not contain local dialects. The demonstrator was selected based on the ability to practice the process of making pickled fruits. Meanwhile, the dubber was selected by considering proper pronunciation, clear voice, and no local dialect.

4.3 Development of initial product

This stage was started with video shooting using a Sony NX100 camera of a single Exmor R sensor with a high-definition 1920 x 1080 resolution at 60p. The lighting used Kino Flo 6-bank LED lighting with uniform light distribution and lower power consumption compared to light output. Besides, the color temperature was stable when the light level changed, and the light was naturally soft color [35]. Lighting with maximum intensity and white/daylight was preferred so that the object's shadow can be entirely avoided. Shadows in the foreground video can be identified as distinct colors due to the imperfect chroma key processing [36]. Tripod Pro NX100 was used throughout the recording process to stabilize images. Boya BY WM8 clip-on microphones with voice-over techniques were used to record audio. The setting process of the camera and the supporting equipment spent 2 hours.

The presenter's shooting process was conducted for 2 hours at TV Studio UNY with a green screen backdrop. The use of the green screen was intended to simplify the editing process. The demonstration scene was recorded at the Chemistry Laboratory of the Faculty of Engineering UNY. The material preparation for the demonstration scene took 8 hours, including drying the mangoes. Meanwhile, the recording lasted for 4 hours.

Two cameras mounted in front and next to the presenter were used to capture the presenter session. Two cameras also recorded the demonstration session. A camera was put in front of the production area, and another camera moved to capture b-roll. The camera layout determined the camera angle to avoid monotonous views [37]. The camera angle was essential to show the variation so that it included the eye-level angle and other angles. Eye-level referred to a method of taking pictures from the presenter's front side with a parallel point of view [38]. Video delivery used a variety of shooting techniques such as long shoot (LS), medium shot (MS), close up (CU), high angle, and eye level.

The next stage was the video editing process using Adobe Premiere Pro CC 2017 and Adobe After Effect. The video editing combined audio, visual source, animation, text, music, and transitions. High-quality media in screen presentation and design consisted of text, picture, animation, and audio [39].

The video consisted of the opening, content, and closing sections. The presenter delivered the opening section, which explained the raw materials, products, preservation techniques, and packaging (Figure 3). The MS technique recorded this section. The presenter's explanation included pictures, text, and 2D animation (Figure 3) to vary the scene layout to prevent boredom. The texts acted as keywords to ease understanding. 2D animation was used to illustrate the concept of preservation using a high concentration of sugar through reducing water activity (a_w) of foodstuffs.

Fig. 3. The picture, text and animation insertion in the opening section

The content section covered the material and tool preparation, the production process, and expired date evaluation. The contents were performed by the demonstrator and guided by the dubber narration. The shooting was taken from chest to waist because facial expressions were not needed in this part. The presenter did not appear during the demonstration session to avoid focus distraction [34] because the audiences were expected to pay attention to the making process's details. The presence of the presenter in the demonstration session will divide the user's concentration [22].

Tool and material preparation (Figure 4) was taken using LS, CU, and high angle techniques. The LS technique was used to record the whole capture of equipment and materials. CU and high-angle techniques were used to show tools and materials one by one. Within this section, text annotations were used to explain the tool name, the material name, and the material size.

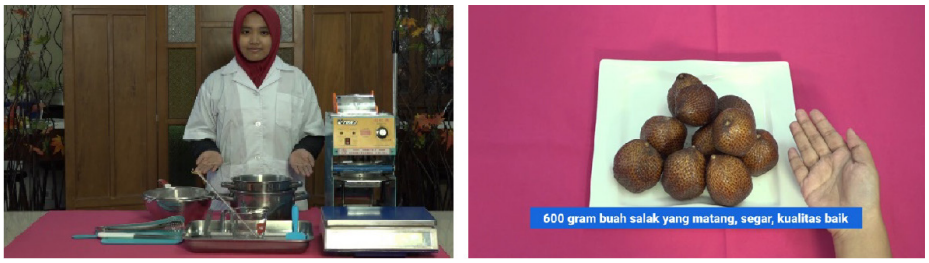

Fig. 4. Tool and material preparation

The production process (Figure 5) was recorded using MS, high angle, eye level, and CU techniques. The method of wet pickled fruits making included packaging steriliza-tion, stripping, reducing size, blanching, soaking in citric acid and sugar solution, as well as packaging. The process of dry pickled fruits making contained stripping, re-ducing size, soaking in a lime solution, washing, boiling with sugar, drain-ing, mechani-cal drying with cabinet dryer or manual drying, sowing granulated sugar, and packag-ing. The production process part ended with the yield calculation.

Fig. 5. Wet and dry pickled fruit production

Figure 6 shows the expiration test. The demonstrator performed the organoleptic test to assess color, aroma, texture, and taste. This section was taken through the MS techniques by displaying half of the body from the stomach upward to show the face. The use of MS techniques in this section aimed at demonstrating the demonstrators' activity when conducting the organoleptic tests involving observing, smelling, tasting, and trying the product. The product expiration time decision was based on the products' organoleptic tests, which were stored for 1 to 2 weeks. The expiration time was based on the changes in the organoleptic nature of the product. This visualization of the expi-ration time was assisted with the observation table (Figure 6).

Fig. 6. Organoleptic testing and expired date evaluation

The last part of this video was the closing section delivered by the presenter, which explained the evaluation and conclusions (Figure 7). The conclusion section was taken with MS technique and equipped with text annotations written in round shapes. The total duration of the video was 16 minutes and 58 seconds.

Fig. 7. The closing section was equipped with text annotation

4.4 Preliminary field testing

Video feasibility assessment was carried out by the material expert and the media expert. Tables 2 and 3 show the video feasibility assessment from both experts. The material experts' assessment result was 96.7%, and the media experts' feasibility test was 93.2%. The video can be categorized as very feasible for both the quality of the material and the media. This video also obtained the highest score on the usage aspect because its operation was easy, simple, and practical.

Table 2. The result of the feasibility test based on material quality

Aspects	Material Experts		Teachers	
	Feasibility, %	Category	Feasibility, %	Category
Learning	96.4	Very Feasible	92.9	Very Feasible
Material	96.2	Very Feasible	89.4	Very Feasible
Benefit	95.0	Very Feasible	100.0	Very Feasible
Usage	100.0	Very Feasible	97.5	Very Feasible
Total	96.7	Very Feasible	93.3	Very Feasible

Table 3. The result of the feasibility test based on media quality

Aspects	Media Expert		Peer Reviewers	
	Feasibility, %	Category	Feasibility, %	Category
Media	92.7	Very Feasible	95.8	Very Feasible
Benefit	87.5	Very Feasible	87.5	Very Feasible
Usage	96.4	Very Feasible	96.4	Very Feasible
Total	93.2	Very Feasible	95.5	Very Feasible

4.5 Main product revision

Based on the material experts and media experts' assessment, the video production team discussed several things that needed to be revised, as follows. The font and image sizes should be enlarged to attract the user's attention. The sound recordings need to be edited to reduce noise in the video. The total duration of the video should be trimmed to reach a maximum length of 15 minutes. The changing between scenes should be smoothened by the addition of transition techniques [40]. Besides, there are several dissimilarities between the narrator's voice and the script, so that the voice recording should be retaken in some scenes. Texts were also added to some presenter scenes to emphasize the clarity of the delivered message. After five times revisions, the duration of final video was 14 minutes 48 seconds, and the file extensions was mp4.

4.6 Main field testing

The video was then assessed its feasibility by two teachers and two peer reviewers. The teacher assessment used a material quality questionnaire. The results of the teachers' assessment can be seen in Table 2. The video obtained a total percentage of 93.3%, and it was categorized as very feasible.

Meanwhile, the peer reviewer assessments used the questionnaire based on media quality. The result indicated that the video was in the very feasible category with a total percentage of 95.5%, in which all aspects can be categorized as very feasible, as presented in Table 3. This implied that the video could be utilized as a supplementary material to improve the learning process, which was consistent with the purpose of this video-making [41]. Also, the video visualization was made with high-resolution digital technology that had met the video feasibility criteria [18].

The video was also assessed by four students in one-on-one testing and 36 students in classroom design (Table 4). The results were 92.3% for one-on-one testing and 87.4% for classroom testing. Therefore, this video falls into a very feasible category.

This video's results have similarities with the video of garlic snack making, which reported that the students' assessment was lower than the material and media experts [11]. It is caused by a generation gap between the material and media experts and university students [42]. The students belonging to Generation Z are more familiar with technology and virtual information, so they have high expectations for audio-visual standards.

Table 4. Video assessment by students

Aspects	One-on-One Testing		Classroom Testing	
	Feasibility, %	Category	Feasibility, %	Category
Learning	91.3	Very Feasible	86.8	Very Feasible
Media	89.2	Very Feasible	87.0	Very Feasible
Material	98.4	Very Feasible	87.5	Very Feasible
Benefit	91.3	Very Feasible	87.1	Very Feasible
Usage	96.3	Very Feasible	89.0	Very Feasible
Total	92.3	Very Feasible	87.4	Very Feasible

4.7 Operational product revision

The peer reviewers did not give any suggestions, but the teachers provided feedbacks for some revisions. One teacher suggested that the demonstrator use a mask and gloves to avoid contamination and personal protective equipment. All the demonstration scenes should be retaken to perform this suggestion. The retaking process was not possible because funds limited the production of this video. This suggestion would be follow up for other video production in Food Preservation Technology course.

This teacher also suggested weighing the dry pickled fruit since it was useful for labeling net-weight. This video has two contents, wet and dry pickled fruit. The weighing scene had been shown in the wet pickled fruit section. The weighing process was considered a simple and easy process, so that it was not necessary to be repeated in the dry pickled fruit section. The weighing scenes of dry pickled mangoes had been presented to show the yield calculation. Therefore, the weighing process was not repeated on the dry pickled fruit to maintain the video duration.

This teacher also suggested that 5 panelists carried out the organoleptic test. The organoleptic testing scene was shown to illustrate how to perform sensory evaluation of the product, demonstrated by a panelist. The demonstration by a panelist was considered to be informative and educational. This scene has been able to elevate users' understanding to carry out organoleptic tests appropriately. If this scene recorded five panelists, the students' concentration would be distracted due to the repetition of similar scenes [23].

Another teacher suggested that the concept of preservation should be explained with the plasmolysis concept. The video content at the minute of 1:34 had already told the idea of preservation using high sugar content in the form of 2D animation (Figure 3). The animation explained that high sugar levels cause microorganism cells to lose the free water content beneficial for the growth of microorganisms. This learning video had already lasted 14 minutes 58 seconds and was limited to a maximum length of 15 minutes [18]. Suppose the animation of the plasmolysis concept was included in this video. In that case, the video's duration could be more than 15 minutes, and it did not meet the criteria of demonstration video feasibility. This video was a demonstration type whose purpose was to demonstrate to users about the tools, materials, and making processes [22]. Videos should focus on specific goals and topics.

Therefore, the production team decided not to revise by considering the video duration. Meanwhile, the feedback regarding personal protective equipment will be accommodated in the subsequent video development because it was challenging to retake all demonstration session scenes due to limited funds and time.

Students' feedback in one-on-one testing and classroom testing was on the noise reduction and smoothing scene transition. For these reasons, the video was revised for both aspects.

4.8 Operational field testing

This stage was a video assessment of 29 students who took this course. Before watching the video in class, the students were asked to complete a pre-test. The students watched the video in the class through an LCD projector and a white screen. While watching, they were asked to fill out the feasibility test questionnaire and post-test.

The feasibility test total score was 83.6%. It consisted of learning 82.4%, media 82.5%, material 86.4%, benefit 85.0%, and usage 83.4%. The results of the pre-test and post-test can be seen in Table 5. Meanwhile, the t-test analysis of the pre-test and post-test scores showed significant differences ($p < 0.05$). Based on the course instructors' observations, the independence of students while doing practice had increased after students used this demonstration video. Therefore, this video effectively enhanced students' readiness to perform the practical session in the laboratory, related to tool and material preparation, production steps, and expiration testing in making pickled fruits.

Table 5. The paired t-test between pre-test and post-test

	Pre-Test	**Post-Test**
Mean	8.8621	16.8276
Variance	5.6232	1.2906
Observations	29	29
Hypothesized Mean Difference	0	
df	28	
t Stat	–20.1442	
P(T<=t) two-tail	$3.3598.\ 10^{-18}$	
t Critical two-tail	2.0484	

The results of this study confirmed a finding from medical education. It stated that the use of demonstration videos in flipped classrooms for dermatology residents effectively improved procedural skills and self-confidence [16]. This article showed that demonstration videos could also be implemented in food technology flipped classrooms to prepare students' readiness before doing a practical job in the laboratory. Those demonstration videos in medical education applied the same style as our developed video. They were annotated using animations, labels, and diagrams. Those videos also were explained using audio recording [16].

However, the pre-test and post-test in our findings did not include psychomotor skills. Future research must focus on measuring the students' performance skill when they perform the practical session in flipped classroom design.

4.9 Final product revision

During the operational field testing, the students did not provide any suggestions for revisions. Even when the video was ended in the classroom, almost all students clapped their hands. The students also wrote praise comments in their open questionnaire, such as "good," "awesome," or "keep your good work." It indicated that this video did not require any further revision.

4.10 Dissemination and implementation

The learning video was then uploaded on the YouTube channel Boga UNY with the URL https://youtu.be/48y0hSyFvGk. YouTube was chosen because it provided the best video quality for video streaming and was suitable for multimedia applications in education [43]. The learning video on making pickled fruits have already received a copyright certificate. The video is embedded in the LMS to be used in the flipped classroom learning in the Food Preservation Technology course.

Many findings reported the struggle to develop learning videos that were preferred by Generation Z. The time needed for material preparation to provide a learning video for flipped classroom design is more outrageous than conventional lectures. The education institutions are recommended to support funds to develop such videos. Few reports described the development and implementation of demonstration videos in the field of food technology, so this video will guide teachers to develop videos preferred by Generation Z in this subject.

5 Conclusion

The study developed a learning video that explained the process of making pickled fruits. The video was in the form of a demonstration video which contained the opening, content, and closing section. The presenter greeted the audience in the opening section. A demonstrator visualized the content section. The presenter did not present in the demonstration sessions to avoid the audience's focus distraction. The content section consisted of tool and material preparation, production process, and expired date evaluation. This session also used voice-over techniques to support the demonstration process. The presenter delivered the closing section and explaining about the evaluation results and conclusions. The video was annotated with text, images, 2D animation, effects, and transitions to elevate users' understanding. The students preferred these visual insertions. Nevertheless, the demonstrator did not use the equipment which supports personal hygiene. The demonstrator's personal hygiene and uniform details should be considered more thoroughly in the video production. The demonstration video was useful to prepare students' readiness before performing a practical session in the laboratory. Therefore, the demonstration videos are recommended to be implemented in a flipped classroom design. The videos are embedded in the LMS for self-directed asynchronous learning. The students then come to the laboratory to practice activities, as explained in the video. Further research is necessary to study whether demonstration videos can improve students' psychomotor skills.

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8 Authors

Andian Ari Anggraeni is a a lecturer in Universitas Negeri Yogyakarta, Faculty of Engineering, Culinary Science study program in Yogyakarta, Indonesia. Her research interest includes pastry and bakery product science, functional food, and food science education. She is actively developing learning videos, virtual reality, and blended/online learning courses in Food Science and Technology.

Sumaryana had been graduated from bachelor's degree of Culinary Science study program, Universitas Negeri Yogyakarta, Yogyakarta, Indonesia (email: sumaryana.2016@student.uny.ac.id).

Wika Rinawati is a lecturer in the Universitas Negeri Yogyakarta, Faculty of Engineering, Culinary Science study program, Yogyakarta, Indonesia. Her research interest is learning media technology. She frequently engaged in video production in food production and food and beverage service (email: wika@uny.ac.id).

Dewi Eka Murniati is a lecturer in the Universitas Negeri Yogyakarta, Faculty of Engineering, Culinary Science study program, Yogyakarta, Indonesia. Her research interests are in hospitality and tourism management, digital marketing, and vocational education (email: dewi_ekamurniati@uny.ac.id).

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