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Research Article

Development of video-based instruction to enhance high school students' learning of shallot tea processing

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Abstract

This study aimed to develop and evaluate video-based instruction on shallot tea processing, compare Grade 9 students' learning achievement before and after the intervention, investigate their satisfaction, and examine relationships among the satisfaction components. The study employed a research and development approach combined with a one-group pretest–posttest design. The participants were 36 Grade 9 students at Surin Ratchamongkol School, Thailand, selected through purposive sampling. The research instruments comprised video-based instruction on shallot tea processing, a learning achievement test, and a 15-item satisfaction questionnaire covering content, visual presentation, and audio presentation. The instruments were evaluated by three experts. Data were analyzed using mean, standard deviation, Cronbach's alpha, corrected item–total correlation, a paired-samples t test, the Shapiro–Wilk test, and Spearman's rank correlation coefficient. The findings showed that the developed video systematically presented six components of shallot tea processing and received a high overall quality rating from the experts (M = 4.33). Students' posttest scores (M = 14.86, SD = 0.351) were significantly higher than their pretest scores (M = 10.81, SD = 1.546), $t(35) = 15.356$, $p < .001$. Overall student satisfaction was high (M = 4.23, SD = 0.664), with content receiving the highest rating. The satisfaction questionnaire demonstrated excellent internal consistency ($\alpha = .918$). Significant positive relationships were found among satisfaction with content, visual presentation, and audio presentation ($r_s = .544–.763$, $p < .001$). These findings indicate that video-based instruction, when integrated with demonstrations and hands-on activities, has potential to support students' learning of agricultural product-processing procedures.

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Introduction

Basic education is no longer limited to the transmission of subject-matter knowledge. Increasing emphasis is placed on developing learners' abilities to apply knowledge in daily life, future employment, and the value-added utilization of locally available resources. In Thailand, the learning area of occupations aims to develop learners' knowledge, practical skills, creativity, responsibility, problem-solving abilities, and appropriate use of technology in work-related activities.

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Accordingly, learning activities should connect academic content with authentic practice and learners' local contexts, thereby establishing a foundation for further education and future careers (Ministry of Education, 2017). This educational direction is consistent with the emphasis of the United Nations Educational, Scientific and Cultural Organization on developing the knowledge, skills, values, and attitudes required for work, life, and sustainable societal development (United Nations Educational, Scientific and Cultural Organization [UNESCO], 2022).

Agricultural product processing provides a meaningful context for developing students' practical and vocational skills because it enables learners to integrate knowledge of agricultural raw materials, production procedures, hygiene, safety, and value addition through hands-on activities. Shallots (*Allium ascalonicum* L.) are widely cultivated in several regions of Thailand and can be processed into various value-added products. Musika and Musika (2021) demonstrated the potential of shallots as raw materials for developing herbal tea products. Their findings indicate that shallots can be used not only as culinary ingredients but also as agricultural raw materials for value-added beverage development. Therefore, using school-grown shallots as a learning resource for shallot tea processing can connect classroom instruction with authentic agricultural activities. Such learning may help students understand agricultural processing procedures, recognize the value of local agricultural products, and explore opportunities for using locally available resources productively.

Nevertheless, teaching agricultural product processing involves procedural knowledge consisting of several interconnected steps, including raw-material selection, preparation, processing, storage, packaging, and product utilization. Verbal explanations or written materials alone may not sufficiently enable learners to visualize the details and relationships among these steps. This limitation is particularly important when learners differ in their prior knowledge, learning pace, and ability to understand practical procedures. Instructional media that clearly demonstrate each step and allow students to review the content according to their individual needs are therefore necessary. Evidence from occupational education in Thailand has shown that interactive video can support independent learning, systematic practice, and the development of procedural skills. Panti et al. (2020), for example, found that video-based instruction enabled students to follow practical procedures independently, attain the specified skill criteria, and express a high level of satisfaction with the learning media.

Video-based instruction is particularly suitable for teaching procedural knowledge because it integrates moving images, narration, text, and demonstrations. These components allow learners to observe the sequence of actions and essential details of each procedure more clearly than text-based instruction alone. Learners can also pause, replay, and review sections that they do not fully understand. Biard et al. (2018) found that segmenting instructional videos and allowing learners to control the pace of presentation facilitated procedural learning and reduced cognitive load. Similarly, Chunggis and Prammanee (2017) reported that learners' practical skills after learning through instructional video based on the flipped classroom concept were significantly higher than their pre-learning skills. These findings suggest that appropriately designed instructional videos can support both knowledge acquisition and the development of practical skills.

The educational value of instructional videos, however, does not result merely from the inclusion of images and sound. It also depends on content accuracy, clarity of demonstration, logical sequencing, suitable pacing, and alignment between media components and intended learning outcomes. Video content should be organized into concise and manageable sections so that learners can focus on essential information and review each procedure conveniently. Sangwisuth and Dithiyont (2023) found that video media developed according to microlearning principles were rated as highly appropriate for learning through mobile technology. Their findings underscore the importance of concise content, systematic sequencing, accessibility, and learner control in video-based instruction. Thus, an instructional video for agricultural product processing should clearly demonstrate each stage of the process while avoiding unnecessary information that may increase learners' cognitive load.

At Surin Ratchamongkol School, Grade 9 students study occupational subjects and participate in school-based shallot cultivation. However, instructional media that systematically demonstrate how harvested shallots can be processed into value-added products remain limited. Consequently, students may not fully connect their knowledge of

agricultural production with product processing and value addition. Developing an instructional video on shallot tea processing may provide students with clear, accessible, and reviewable learning content. It may also support the integration of occupational education with agricultural resources available in the school and local community. Despite the growing use of instructional videos in education, limited evidence is available regarding their application to teaching secondary school students the processing of locally produced agricultural materials, particularly shallot tea processing. Investigation within this specific context is therefore warranted.

Objectives

Based on the rationale and significance described above, the objectives of this study were as follows:

- To develop video-based instruction on shallot tea processing for Grade 9 students.
- To evaluate the quality of the developed video-based instruction through expert assessment.
- To compare students' learning achievement before and after learning through the video-based instruction.
- To investigate students' satisfaction with the developed video-based instruction.
- To examine the relationships among students' satisfaction with the content, visual presentation, and audio presentation of the developed video-based instruction.

Method

Research Design

This study employed a research and development approach combined with a one-group pretest–posttest design. The study involved the systematic development of video-based instruction on shallot tea processing, expert evaluation of the developed media, implementation with the participating students, comparison of their learning achievement before and after the intervention, and assessment of their satisfaction with the video-based instruction.

Participants

The population consisted of 296 students enrolled at Surin Ratchamongkol School, Mueang Surin District, Surin Province, Thailand, during the 2025 academic year. The participants were 36 Grade 9 students enrolled in the occupations course during the second semester of the 2025 academic year. They were selected through purposive sampling because they participated in school-based shallot cultivation and studied content related to occupational skills and agricultural product processing.

Research Instruments

Three research instruments were used in this study:

Video-based instruction on shallot tea processing. The instructional video covered essential content related to shallot tea, including shallot selection, raw-material preparation, drying, tea processing, brewing, and product packaging. Images, narration, captions, and step-by-step demonstrations were integrated to facilitate students' understanding of the processing procedures.

Learning achievement test. A multiple-choice test was administered before and after the learning intervention to assess students' knowledge and understanding of shallot tea processing. The same content framework and scoring criteria were applied to both the pretest and posttest.

Student satisfaction questionnaire. The questionnaire consisted of 15 items covering three components of the video-based instruction: content, visual presentation, and audio presentation. It employed a five-point Likert-type rating scale ranging from 1 (*least satisfied*) to 5 (*very satisfied*) (Likert, 1932). The mean scores were interpreted using five levels adapted from Srisa-ard (2017): 4.51–5.00 indicated very high satisfaction, 3.51–4.50 indicated high satisfaction, 2.51–3.50 indicated moderate satisfaction, 1.51–2.50 indicated low satisfaction, and 1.00–1.50 indicated very low satisfaction. A mean score of 2.51 or higher was considered an acceptable level of satisfaction.

Development and Quality Evaluation of the Research Instruments

The video-based instruction was developed through a systematic process. First, the researchers analyzed the Grade 9 occupations curriculum, relevant content on shallot tea processing, learners' characteristics, and the intended learning

outcomes. Second, the content structure and video script were designed by specifying the sequence of information, practical demonstrations, visual presentations, narration, and captions. Third, materials and equipment for shallot tea processing and video production were prepared. The video was then recorded according to the approved script, with particular attention given to the clarity and continuity of each processing step. Finally, the recorded materials were edited by improving the images and audio, inserting captions, and arranging the content into a coherent instructional sequence. The developed video and research instruments were evaluated by three experts in occupations and educational technology. The experts assessed the accuracy, clarity, appropriateness, and alignment of the video content with the learning objectives. Content validity of the achievement test and satisfaction questionnaire was examined using the Index of Item–Objective Congruence (IOC). Items with an IOC value of 0.50 or higher were retained, while items below the criterion were revised according to the experts' recommendations before being used for data collection. The internal consistency of the student satisfaction questionnaire was examined using Cronbach's alpha. Corrected item–total correlations were also calculated, with values of .30 or higher considered acceptable.

Data Collection

Data were collected during the second semester of the 2025 academic year. Before the learning activity, the participating students completed the pretest to determine their prior knowledge of shallot tea processing. The students then learned through the developed video, which demonstrated the procedures from raw-material selection and preparation to processing, brewing, and packaging.

After completing the learning activity, the students took the posttest to assess their learning achievement. They subsequently completed the satisfaction questionnaire to indicate their perceptions of the content, visual presentation, and audio presentation of the video-based instruction. All 36 completed sets of data were included in the analysis.

Data Analysis

Descriptive statistics, including frequency, percentage, mean, and standard deviation, were used to analyze the expert evaluation results and students' satisfaction. The internal consistency reliability of the student satisfaction questionnaire was examined using Cronbach's alpha, and corrected item–total correlations were calculated for individual items. A paired-samples t test was used to compare students' pretest and posttest scores. The normality of the satisfaction component scores was examined using the Shapiro–Wilk test. Because these scores were not normally distributed, Spearman's rank correlation coefficient was used to examine the relationships among satisfaction with the content, visual presentation, and audio presentation of the developed video-based instruction. Statistical significance was determined at the .05 level.

Results

The findings are presented according to the five research objectives: (1) development of the video-based instruction, (2) expert evaluation of its quality, (3) comparison of students' pretest and posttest scores, (4) assessment of students' satisfaction, and (5) examination of the relationships among the satisfaction components. Complete data from all 36 participating students were included in the analysis.

Development of the Video-Based Instruction on Shallot Tea Processing

The first research objective was to develop video-based instruction on shallot tea processing for Grade 9 students. The developed instructional video was designed in accordance with the learning content of the occupations course, the characteristics of Grade 9 students, and the intended learning outcomes related to agricultural product processing.

The development process comprised five major stages: (1) analysis of the curriculum, instructional content, learner characteristics, and learning objectives; (2) organization of the content and preparation of the video script; (3) preparation of raw materials, processing equipment, and video-production equipment; (4) video recording based on the prepared script; and (5) video editing and improvement. During the editing stage, narration, captions, illustrations, and relevant visual elements were incorporated to improve the clarity and continuity of the presentation.

The completed video presented the process of shallot tea production in a systematic sequence. Its content was organized into six principal components: (1) an introduction to shallots and shallot tea, (2) selection of suitable shallots,

(3) preparation of raw materials and equipment, (4) drying and processing of the shallots, (5) preparation and brewing of shallot tea, and (6) packaging and utilization of the finished product. Practical demonstrations were presented through close-up images, narration, and captions to enable students to clearly observe and follow each processing step.

The developed video-based instruction was designed for use in conjunction with hands-on learning activities. Students viewed the demonstrations and subsequently participated in shallot tea processing under the researchers' guidance. The video could also be paused, replayed, and reviewed, allowing students to learn and revisit individual processing steps according to their needs. The resulting instructional media therefore connected school-based shallot cultivation with agricultural product processing and value-added utilization.

The principal components of the developed video-based instruction are presented in Table 1.

Table 1. Content components of the developed video-based instruction

Component	Content and learning focus
Introduction to shallot tea	Background information and the value of processing shallots into a beverage product
Raw-material selection	Selection of appropriate shallots for processing
Preparation	Preparation of shallots, other ingredients, materials, and equipment
Drying and processing	Step-by-step demonstration of shallot preparation and drying
Tea preparation and brewing	Procedures for preparing and brewing the processed shallot tea
Packaging and utilization	Packaging, storage, and appropriate use of the finished product

Overall, the development process resulted in a complete video-based instructional medium that systematically demonstrated shallot tea processing and was ready for expert quality evaluation prior to implementation with the participating students. The results of the expert evaluation are presented in the following section.

Quality Evaluation of the Developed Video-Based Instruction

The second research objective was to evaluate the quality of the developed video-based instruction through expert assessment. The completed instructional video was evaluated by three experts in occupations and educational technology. The evaluation covered the accuracy and appropriateness of the content, clarity and sequence of the processing demonstrations, quality of the visual and audio presentations, and suitability of the video for Grade 9 students.

The expert evaluation results indicated that the developed video-based instruction had a high overall level of quality (M = 4.33, SD = 0.076). This finding demonstrated that the video content was accurate and appropriately organized, the shallot tea processing procedures were presented in a clear and systematic sequence, and the visual and audio components were suitable for supporting student learning. The experts therefore considered the developed video-based instruction appropriate for implementation with Grade 9 students.

Table 2. Expert evaluation of the developed video-based instruction

Evaluation result	Number of experts	*M*	*SD*	Interpretation
Overall quality of the video-based instruction	3	4.33	0.076	High

Based on the expert feedback, minor revisions were made to improve the clarity of the narration, captions, visual presentation, and sequence of the processing demonstrations. After these revisions, the video-based instruction was considered ready for implementation with the participating students.

Comparison of Students' Learning Achievement before and after the Intervention

The third research objective was to compare students' learning achievement before and after learning through the video-based instruction on shallot tea processing. Pretest and posttest scores from all 36 participating students were analyzed using a paired-samples t test.

As presented in Table 3, the students obtained a mean pretest score of 10.81 (SD = 1.546), whereas their mean posttest score was 14.86 (SD = 0.351). The posttest mean was 4.05 points higher than the pretest mean. In addition, the lower standard deviation of the posttest scores indicated that students' scores were less dispersed after the learning intervention.

The paired-samples *t* test revealed that the students' posttest scores were significantly higher than their pretest scores, $t(35) = 15.356$, $p < .001$. The result indicated that students demonstrated greater knowledge and understanding of shallot tea processing after participating in the learning activities supported by the developed video-based instruction.

Table 3. Comparison of students' learning achievement before and after the intervention

Assessment	*n*	*M*	*SD*	M	*t*	*df*	*p*
Pretest	36	10.81	1.546	4.05	15.356	35	< .001
Posttest	36	14.86	0.351				

Note. Statistical significance was determined at the .05 level.

Overall, the findings supported the research hypothesis that students' learning achievement after learning through the video-based instruction would be significantly higher than their achievement before the intervention.

Students' Satisfaction with the Developed Video-Based Instruction

The fourth research objective was to investigate students' satisfaction with the developed video-based instruction on shallot tea processing. The satisfaction questionnaire consisted of 15 items across three components: content, visual presentation, and audio presentation. Responses from all 36 participating students were analyzed using the mean and standard deviation.

The student satisfaction questionnaire demonstrated excellent overall internal consistency ($\alpha = .918$). Cronbach's alpha coefficients for the content, visual presentation, and audio presentation components were .807, .826, and .813, respectively. The corrected item–total correlations ranged from .397 to .787, exceeding the acceptable criterion of .30; therefore, all 15 items were retained for analysis.

Satisfaction with the Content

As presented in Table 4, students' satisfaction with the content component was at a high level overall ($M = 4.29$, $SD = 0.716$). The highest-rated item was the extent to which the video facilitated students' understanding of shallot tea processing ($M = 4.58$, $SD = 0.604$), which was rated at a very high level. This was followed by the systematic and continuous sequence of the content ($M = 4.47$, $SD = 0.654$). The item concerning the ability of the video to stimulate students' interest and attention received the lowest mean score ($M = 4.03$, $SD = 1.320$), although it remained at a high level.

Table 4. Students' satisfaction with the content of the video-based instruction

Content component	*M*	*SD*	Interpretation
1. The video facilitated understanding of shallot tea processing.	4.58	0.604	Very high
2. The content was presented in a continuous and systematic sequence.	4.47	0.654	High
3. The explanations were clear, understandable, and easy to follow in practice.	4.31	0.856	High
4. The duration of the presentation was appropriate.	4.08	1.131	High
5. The video stimulated interest and attention in learning.	4.03	1.320	High
Overall content	**4.29**	**0.716**	**High**

Satisfaction with the Visual Presentation

As shown in Table 5, students' overall satisfaction with the visual presentation was at a high level ($M = 4.18$, $SD = 0.776$). The attractiveness and ability of the images to engage students received the highest rating ($M = 4.39$, $SD = 0.871$), followed by the clarity and visibility of visual details ($M = 4.36$, $SD = 0.762$). The appropriateness of the colors used in the video received the lowest mean score ($M = 4.00$, $SD = 1.146$), but it was still rated at a high level.

Table 5. Students' satisfaction with the visual presentation of the video-based instruction

Visual presentation component	*M*	*SD*	Interpretation
1. The images were attractive, interesting, and engaging.	4.39	0.871	High
2. The images were clear and showed sufficient detail.	4.36	0.762	High
3. The camera angles appropriately demonstrated the processing procedures.	4.08	0.967	High
4. The colors were appropriate and neither excessively bright nor too dull.	4.00	1.146	High
5. The sequence of images facilitated understanding of the processing procedures.	4.11	1.237	High
Overall visual presentation	**4.18**	**0.776**	**High**

Satisfaction with the Audio Presentation

As presented in Table 6, students' overall satisfaction with the audio presentation was at a high level (M = 4.20, SD = 0.723). The appropriateness of the audio volume received the highest mean score (M = 4.31, SD = 0.889). This was followed jointly by the clarity of the narration (M = 4.19, SD = 1.037) and the consistency between the narration, images, and content (M = 4.19, SD = 0.856). The narration speed received the lowest mean score in this component (M = 4.14, SD = 0.798), although it remained at a high level.

Table 6. Students' satisfaction with the audio presentation of the video-based instruction

Audio presentation component	*M*	*SD*	Interpretation
1. The narration was clear and easy to understand.	4.19	1.037	High
2. The audio volume was appropriate.	4.31	0.889	High
3. The narration speed was appropriate for learning.	4.14	0.798	High
4. The narration was consistent with the images and content.	4.19	0.856	High
5. The overall audio quality supported understanding of the lesson.	4.17	1.159	High
Overall audio presentation	**4.20**	**0.723**	**High**

Overall Satisfaction

The combined results are summarized in Table 7. Students reported a high level of satisfaction with all three components of the video-based instruction. Content received the highest mean score, followed by audio presentation and visual presentation. Overall satisfaction with the developed video was also at a high level (M = 4.23, SD = 0.821).

Table 7. Summary of students' satisfaction with the developed video-based instruction

Satisfaction component	*M*	*SD*	Interpretation	Rank
Content	4.29	0.716	High	1
Audio presentation	4.20	0.723	High	2
Visual presentation	4.18	0.776	High	3
Overall	**4.23**	**0.821**	**High**	—

Overall, the findings indicated that students responded positively to every evaluated component of the video-based instruction. The highest-rated item demonstrated that the video helped students understand shallot tea processing more easily. Nevertheless, the comparatively lower ratings and larger standard deviations for learning stimulation, image sequencing, and overall audio quality suggest that students' perceptions of these elements were more varied. These components may therefore be prioritized when further improving the instructional video.

Relationships Among the Components of Students' Satisfaction

Spearman's rank correlation analysis was conducted to examine the relationships among students' satisfaction with the content, visual presentation, and audio presentation of the developed video-based instruction. This nonparametric statistic was selected because the component scores were not normally distributed.

Table 8. Spearman's rank correlations among the components of students' satisfaction

Component	1	2	3
1. Content	1.000		
2. Visual presentation	.763***	1.000	
3. Audio presentation	.544***	.728***	1.000

Significant positive relationships were found among all three satisfaction components. Content was strongly associated with visual presentation (rs=.763, p<.001) and moderately associated with audio presentation (rs=.544, p<.001). Visual presentation was also strongly associated with audio presentation (rs=.728, p<.001). These findings indicate that students who positively perceived one component of the video tended to positively perceive the other components as well.

Discussion

The findings showed that the developed video-based instruction on shallot tea processing was rated highly by the experts, students' posttest scores were significantly higher than their pretest scores, students reported a high level of satisfaction,

and all three satisfaction components were positively correlated. These findings demonstrate the potential of video-based instruction to connect occupational education with practical agricultural processing and the value-added use of locally available resources.

First, the high expert evaluation may be attributed to the systematic development process, which included curriculum and content analysis, script preparation, sequential demonstration, video recording and editing, and expert review. These activities correspond to the preproduction, production, and postproduction phases recommended by Castillo (2021). The video presented the complete process—from raw-material preparation to drying, brewing, and packaging—through coordinated demonstrations, narration, and captions. This format was appropriate because procedural learning requires students to understand both the actions and their correct sequence. The finding is consistent with Panti et al. (2020) and Sangwisuth and Dithiyont (2023), who reported high-quality evaluations of systematically developed instructional videos. It is also supported by research showing that segmentation and learner-paced presentation can facilitate procedural learning and reduce unnecessary cognitive processing (Biard et al., 2018; Fiorella & Mayer, 2018).

The quality of the video can also be explained by multimedia learning principles. Mayer (2021) proposed that learners develop meaningful understanding when relevant verbal and visual information is selected, organized, and integrated with prior knowledge. Similarly, Brame (2016) emphasized that effective educational videos should manage cognitive load, maintain engagement, and encourage active processing. Therefore, the coordination of demonstrations, narration, and captions may have helped students connect processing terminology with the corresponding materials and actions.

The use of shallots cultivated within the school further increased the contextual relevance of the lesson by linking students' agricultural experience with product processing and value addition. Musika and Musika (2021) demonstrated the potential of shallots as raw materials for herbal tea production. Nevertheless, the present study focused on learning and agricultural processing and did not assess the chemical composition, antioxidant properties, or health effects of the tea. The findings should therefore not be interpreted as evidence of health benefits.

Second, the increase in students' mean scores from 10.81 on the pretest to 14.86 on the posttest suggests that the intervention enhanced their knowledge of shallot tea processing. The video transformed a multistep procedure into observable actions, allowing students to examine the materials, equipment, techniques, and sequence of production. Demonstration-based videos accompanied by instructional support can promote procedural knowledge and learner motivation (van der Meij & van der Meij, 2016). Likewise, dynamic presentations can communicate changes and sequences that may be difficult to represent through static images (Ploetzner et al., 2021).

The finding is consistent with Chunggis and Prammanee (2017), who reported improved practical skills after video-based instruction. It also supports Noetel et al. (2021), who found that video produced greater learning benefits when it supplemented other instructional activities rather than replacing them. In the present study, the video was integrated with teacher explanations, hands-on activities, and lesson review. Thus, the achievement gain likely resulted from the combined learning experience rather than from the video alone.

However, the improvement should be interpreted cautiously because the study used a one-group pretest–posttest design without a control group. The effects of the video cannot be separated from those of teacher guidance, practice, and review. Moreover, the posttest mean of 14.86 out of 15 suggests a possible ceiling effect, which may have limited the test's ability to differentiate among high-achieving students. Future studies should include a comparison group, delayed retention measurement, and an achievement test with a broader range of difficulty.

Third, students reported a high level of overall satisfaction, with content receiving the highest mean score, followed by audio and visual presentation. The highest-rated item indicated that the video facilitated students' understanding of shallot tea processing, suggesting that they valued its clarity and practical usefulness. These results are consistent with Thai studies reporting positive student responses to instructional videos for occupational and practical learning (Chunggis & Prammanee, 2017; Panti et al., 2020; Sangwisuth & Dithiyont, 2023). Internationally, educational videos

have also been associated with positive perceptions of instructional quality and usability (Greeves & Oz, 2024; Lamontagne et al., 2021).

The practical and focused presentation may have contributed to students' satisfaction. Video duration, pacing, and presentation style are associated with learner engagement (Guo et al., 2014), while concise narration, visual signaling, and guiding questions can help sustain attention (Brame, 2016). Nevertheless, the lower ratings and greater response variability concerning attention, color, image sequencing, and audio quality indicate opportunities for improvement. Future versions should use shorter segments, clearer transitions, consistent color and lighting, improved audio, and visual cues highlighting essential steps. These revisions are consistent with multimedia design principles (Mayer, 2021) and recommended production practices (Castillo, 2021). Annotations and visual cues could also be used to direct students' attention to important information (Tseng, 2021).

Finally, significant positive correlations were found among content, visual presentation, and audio presentation. The strongest relationship was between content and visual presentation, indicating that students tended to perceive the instructional components as an integrated experience. This finding is consistent with the multimedia perspective that words, images, and sounds should work together to promote learning (Brame, 2016; Mayer, 2021). Clear content may be less effective when demonstrations are difficult to see, while high-quality images may have limited instructional value when narration and sequencing are unclear.

These correlations do not demonstrate causal relationships because all components were measured simultaneously using the same questionnaire. They may partly reflect students' overall favorable perceptions or common-method variance. Nevertheless, the findings indicate that future video development should address content, visual presentation, and audio presentation as an interconnected instructional system.

Overall, the study supports the use of video-based instruction as a supplementary tool for teaching agricultural processing procedures in secondary occupational education. Its principal contribution is the integration of locally relevant agricultural resources, systematic multimedia instruction, and hands-on learning. Stronger experimental designs, larger and more diverse samples, delayed posttests, and performance-based assessments are needed to confirm its effectiveness in developing knowledge retention and actual processing skills.

Recommendations

Based on the findings of this study, the recommendations are divided into recommendations for practice and recommendations for future research.

Recommendations for Practice

- The developed video-based instruction should be integrated with teacher demonstrations and hands-on activities to support students' understanding and practical application of shallot tea processing procedures.
- The video should be divided into short, clearly labeled segments so that students can conveniently pause, replay, and review specific processing steps according to their individual learning needs.
- Future revisions of the video should improve the visual and audio presentation, particularly color consistency, image sequencing, narration speed, sound clarity, and audio volume. Interactive questions or prompts should also be incorporated to maintain students' attention and engagement.
- Student assessment should include both a learning achievement test and a performance-based rubric covering procedural accuracy, hygiene, safety, product quality, teamwork, and packaging.

Recommendations for Future Research

- Future studies should employ a quasi-experimental or randomized controlled design with a comparison group and a larger sample drawn from multiple schools to provide stronger evidence regarding the effectiveness and generalizability of video-based instruction.
- Further research should assess not only students' knowledge and satisfaction but also their practical skills, knowledge retention, ability to transfer learning to the processing of other agricultural products, and the quality and safety of the products they prepare.

- Future studies should compare alternative video designs, such as segmented versus continuous videos and interactive versus non-interactive videos, to determine which instructional features most effectively promote learning achievement, practical skills, and learner engagement.

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