Developing an engaging whiteboard animation video for vitamins

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Abstract. Whiteboard animation videos are engaging learning media for Generation Z. This study aimed to develop and assess the feasibility of a whiteboard animation video for vitamin in the Nutrition Science subject for class X culinary vocational school. This study was research and development using a 4D approach (define, design, develop, disseminate). The define stage analyzed the curriculum, material, student character, learning media, and school facilities. The design stage included the writing and assessing the material, the writing and assessing of storyboards, and production team selection. The develop stage was making a video and assessing the feasibility. Animation images were created using Paint Tool Sai. Image conversion from JPEG to SVG was performed with Inkscape. The dubber's voice was recorded with Universal Audio using the Apollo Twin audio interface and Avantone CV12 microphone. The audio was edited in Pro Tools 2020.9. To produce a whiteboard animation video, animation images, captions, dubber's voice, and back sound were combined with VideoScribe. Videos used mpg format. In order to maintain video duration below 10 minutes, the video was divided into two parts. The assessment of video feasibility was carried out by one media expert and two content experts. The assessment of feasibility at the disseminate stage was carried out to 30 users. Based on the feasibility assessment, this video was very suitable to be applied as a learning medium.

1. Introduction

Digitalization occurs in many areas of people's lives. Teaching and learning in schools must be integrated with digital technology. Teachers and students are required to master information and communication technology (ICT). Students can browse learning resources on the internet, so teachers are not the only source of learning [1].

The current vocational high school students are Generation Z, which was born between 1995-2010 [2]. Characteristics of Generation Z are, having digital literacy skills, mastering new media, and ICT. This generation grew up in the rapid development of digital technology [1]. Generation Z is often called homo globalists because technological developments cause them to grow up in the same culture [3]. They are very dependent on technology, fond of wireless technology, must always be connected to the internet, prefer diversity, and have good skills in social interaction in the digital world [1]. Generation Z students prefer flexible learning, which is not limited by location and time. However, they are less independent, so they need designed instruction, feedback, and regular evaluation [1]. Therefore, the application of ICT-based learning needs to be adapted to the characteristics of Generation Z, one of which is in the form of digital learning media.

Learning media that vocational students prefer today is the video [4]. Video is an audio-visual media that can convey material more effectively because video stimulates the sense of hearing and sight [5].
Video shows learning objects concretely, can achieve cognitive and psychomotor skills, motivates to learn, reduces boredom, increases memory retention, and is attractive to Generation Z and easy to distribute. The use of animation in videos is also preferred by Generation Z [6].

Whiteboard animation video is a popular learning media these days. Whiteboard animation video shows the process of drawing objects, and accompanied by narrator explanation. This animation is considered engaging. The most prominent feature of whiteboard animation is the simplicity of the images and short captions [7]. Whiteboard animation can be applied at any level of education.

Nutrition Science is a theoretical and practical subject in culinary vocational high school. Nutrition science is studying how to design and process the food needed by the body. Competencies in nutrition science include analyzing vitamins needed by the body [8]. Learning videos about vitamins are widely available on YouTube. However, those videos have many drawbacks. The material presented in the video is incomplete. Recommended daily value (RDV) for vitamins and a complete explanation of vitamin B complex have not been discussed in those current videos. The audio quality is also not good; the sound is noisy and the sound volume is unstable. Some videos do not have any audio. Besides, some videos use Korean-Pop songs as backsound and/or the back sound volume is too loud. Vocational school students, currently generation Z, favour learning videos with clear audio quality [6]. The visual appearance of those videos is also not attractive because it only displays text and a few images. The average length of those videos is 10-20 minutes, so it does not match the standard duration of a learning video which must be under 15 minutes [9]. Up to today, videos for vitamins are still rarely developed using whiteboard animation applications.

Therefore, this research would develop a whiteboard animation video for vitamin using whiteboard animation. This video discussed the description of vitamins, the function of vitamins, types of water-soluble and fat-soluble vitamins, food sources of vitamins, the body need for vitamins, and the effects of vitamin deficiency and hypervitaminosis. This study aimed to develop an animated whiteboard video for vitamins and assess the video feasibility.

2. Method
2.1 Research Method
This study used a research and development model using a 4D development model (define, design, develop, and disseminate). Figure 1 shows the development steps in detail.

![Figure 1. 4D model for whiteboard animation video development](image)

2.2 Feasibility Assessment
The research instrument was composed of closed and open questionnaires of video feasibility for content expert, media expert, and user. The feasibility instrument for content expert covered aspects of learning, content, benefits, and usage. The instrument of media expert feasibility included aspects of media, benefits, and usage. Whereas the instrument for user feasibility consisted of aspects of learning, media, content, benefits, and usage [10]. The instrument was assessed by a construct validity test. The feasibility assessment for the video was carried out by two content experts, one media expert, and 30 users from class X culinary students of SMK N 6 Yogyakarta.

2.3 Data Analysis
The feasibility assessment applied a 4-Likert-scale. Scale meant as follow: 1 very unsuitable, 2 unsuitable, 3 suitable, and 4 very suitable. Data were descriptively analyzed according to formula (1).
Feasibility percentage = \( \frac{\text{Total score}}{\text{Maximum score}} \times 100\% \) \hspace{1cm} (1)

The feasibility percentage was transformed by categorizing data from interval-scale to ordinal-scale, as shown in Table 1 [11].

| Feasibility Percentage | Feasibility Category |
|------------------------|----------------------|
| >80%                   | Very suitable        |
| 66%-80%                | Suitable             |
| 56%-65%                | Unsuitable           |
| <56%                   | Very unsuitable      |

3. Result and Discussion

Whiteboard animation video for vitamin was developed with a 4D approach as follows.

3.1 Define

The curriculum, material, student character, learning media, and school facilities were analyzed at the define stage. Observations were made at SMK N 6 Yogyakarta. Based on curriculum and materials analysis, SMK N 6 Yogyakarta used student-centered learning and ICT in teaching and learning. However, this learning design has not been implemented optimally. The Nutrition Science teacher said that students still had difficulties in understanding the vitamin material. The results of student character analysis showed that student's character and learning style followed the trait of generation Z. Students preferred learning that was individual, interesting, and visual-based and used educational technology. However, learning media at SMK N 6 Yogyakarta was limited to verbal media such as presentation media, handouts, and books. SMK N 6 Yogyakarta had wifi internet facilities and generators that could support learning with ICT. Based on the analysis results at the define stage, this study would develop an animated whiteboard video for vitamins in Nutrition Science.

3.2 Design

The video was divided into two parts: 1) fat-soluble vitamins and 2) water-soluble vitamins. The first step in the design stage was material writing. The video material was adapted from a reference book for a culinary vocational school in nutrition science. Spoken language is different from written language. Therefore, complicated and complex written language must be transformed into a spoken language with a familiar and simple vocabulary and style [12]. A content expert then assessed the feasibility of the material. The material was then revised according to the content expert's feedback. The revision process of the material was carried out eight times.

The material was then developed into a storyboard. The storyboard consisted of a visual section and a narration section that the dubber would read. The storyboard was arranged in a table consisting of several columns: scene number, duration, visual source, and narration. The final visual source would be animated images. Designing animated images was carried out in several stages: drawing design, sketching, sketch feasibility assessments, sketching revisions, image coloring, colored image feasibility assessments, and image coloring revisions. Figure 2 shows the storyboard development flow in the visual section. Meanwhile, the narration writing process went from narration writing, assessing the feasibility of the narration, and revising the narration. Content expert and media expert carry out the feasibility assessment of the storyboard.

The production team consists of a scriptwriter, illustrator, image format editor, dubber, audio editor, and animator. The production team was selected by considering the background, experience, and expertise [13]. The election of illustrators was carried out by selecting a colored image portfolio. The selection was made based on the image's attractiveness and the coloring technique's suitability with the Scribe software. Scribe is not able to support very delicate color gradients and more suitable for bold
colors. This whiteboard animation video used colored images. The dubber selection was made based on the absence of a strong regional accent and the intonation suitability.

![Drawing design process](image)

**Figure 2.** The development flow of the storyboard in the visual section includes: (a) the process from drawing design until it became the final-colored image and (b) the color revision in the image.

### 3.3 Develop

The development of animated videos was carried out with VideoScribe software. First of all, the animated image was drawn using the Paint Tool Sai software with the JPEG image format. The input image on VideoScribe needs the SVG format; therefore, the image format was converted from JPEG to SVG using Inkscape software. The dubber's voice was recorded with the Asus Zenfone m1 cellphone without editing, making the sound unclear and unstable. Based on media expert advice, the dubber's voice was then re-recorded. The dubber voice was then recorded with Universal Audio using the Apollo Twin audio interface and Avantone CV12 microphone. The audio was recorded in a soundproof recording studio. The audio file was then edited with the Pro Tools 2020.9 software. The content expert then suggested re-recording the dubber's voice in several scenes because of material substitutions or additions.

After the animated images and audio recordings were declared suitable, combining images, caption, audio, and back sound was carried out using the VideoScribe software. Captions in the form of keywords were added to the scene, to help students understand the subject [14]. Videos used mpg format. The duration of video 1 and 2 was 7 minutes 24 seconds and 10 minutes 19 seconds. Figures 3 and 4 show captures from the video of fat-soluble vitamins and water-soluble vitamins.

Figure 3(a) shows video thumbnails on YouTube. Thumbnails used attractive images that represent the content of the video. The title of the video was short and easy to understand. The video's title was written in black Comic Sans font, which was easy to read and gave the impression that the video material was not difficult. The main characteristic of whiteboard animation videos is the display of hand movements while drawing or writing. Most of this video's visual appearances were shown in Figure 3(b), where the hand movement was drawing a black and white sketch, then coloring the sketch image. Alternatively, hand gestures were shown while writing the caption. The final images were shown for the last 5 seconds of each scene. Figures 3(c), 3(d), 3(e), 3(f), 4(a), 4(b), 4(c), 4(d), and 4(e) show the visual appearance of the final images. The duration of each scene was determined by the length of the dubber's narration. Most whiteboard animation videos were developed with black and white sketches. However, this study developed a whiteboard animation video with colored images to make it more attractive to Generation Z students. The video was ended with a mind-mapping of all the material, as shown in Figure 4(f).
Figure 3. Video of fat-soluble vitamins, including (a) video thumbnails on Youtube, (b) properties of fat-soluble vitamins, (c) the effect of vitamin A deficiency, (d) the effect of vitamin D hypervitaminosis, (e) function of vitamin E, and (f) vegetable sources and RDV of vitamin A.

In order to help the students to understand the material, text captions using Calibri font were added to several scenes, as shown in Figures 3(b), 3(f), 4(a), and 4(d). Some of the images were designed to visualize the human internal organs. Figure 3(d) shows the kidneys, figure 3(e) shows the fetus, and Figure 4(b) shows the lungs. The human animations were drawn in several distances: long-distance images (Figures 3(c) and 4(e)), medium-distance images (Figures 3(d), 3(e), and 4(b)), and close-up (Figure 4(c)). The focus material needed to be conveyed would determine the distance of taking a human object. A long-distance image showed the uncomfortable feeling experienced by humans. A medium-distance image depicted the pain in the internal organs. In contrast, the visible organs, such as eyes, would be drawn as close-up images.

Figure 4. Video of water-soluble vitamins, including (a) types of vitamin B complex, (b) function of vitamin B₂, (c) the effect of vitamin B₂ deficiency, (d) sources and RDV of vitamin C, (e) the effect of vitamin B₃ hypervitaminosis, and (f) mind-mapping of video material.
Figures 3(f) and 4(d) show food sources of vitamins. Because these foodstuffs had different colors, the background was white to contrast with the main object. Some images used color backgrounds, such as Figures 3(c) and 4(e). Figure 4(a) shows a combination of animation images, text captions, and the narrator's voice in explaining the types of vitamins B complex. The vitamin B text font color was black so that it contrasted with the puzzled color that used soft colors. A contrasting color between the font and the background would make the text easier to read. The text color of vitamin B\textsubscript{1} terminology (e.g., thiamine, niacin, and others) were selected as the same color as the puzzle color to facilitate association. The association will reduce students' cognitive load when viewing videos.

The feasibility of animation videos was assessed by content experts twice and media expert once. The feasibility assessment results are presented in Table 2.

| Table 2. Feasibility assessment of whiteboard animation video by experts |
|-------------------------|----------------------|----------------------|----------------------|
| Aspect     | Content expert | Media expert | Category    |
| Learning   | 95.8 %         | -            | Very suitable |
| Content    | 88.8 %         | -            | Very suitable |
| Media      | -              | 95.0 %       | Very suitable |
| Benefit    | 85.0 %         | 100.0 %      | Very suitable |
| Usage      | 92.5 %         | 100.0 %      | Very suitable |
| Total      | 89.9 %         | 96.7 %       | Very suitable |

The first content expert, a lecturer in Nutrition Science at Universitas Negeri Yogyakarta, suggested several revisions. RDV of vitamins D, E, K, B\textsubscript{1}, B\textsubscript{2}, B\textsubscript{3}, B\textsubscript{5}, B\textsubscript{6}, B\textsubscript{9}, B\textsubscript{12}, and C needed to be revised following the Minister of Health of the Republic of Indonesia's regulation number 28 of the year 2019 concerning the RDV for Indonesian. It also could refer to the regulation of the Head of the Food and Drug Supervisory Agency of the Republic of Indonesia number 9 of the year 2006 concerning nutrition labels. The first content expert also asked for additional explanations about 1) the effects of hypervitaminosis and deficiency, 2) hypervitaminosis of vitamin E and K, and 3) references at the end of the video. The video was then improved according to those suggestions. However, the second content expert, a teacher of Nutrition Science at SMK N 6 Yogyakarta, stated that the material in the video was coherent and very suitable. The characteristic of learning videos is to convey messages effectively [1].

Media experts provided suggestions for video improvement. The video of fat-soluble vitamins should be added with the caption "vitamin function" in the opening scene at time 0:36 and narrating the functions and properties of vitamins that were explained started at time 0:19. The media expert suggested adding captions to all vitamin B terminology. When the dubber mentions the phrase "vitamin B\textsubscript{1}", the caption "thiamin" should be shown with an arrow pointing to B\textsubscript{1} text. These revisions should be applied to other vitamin B complexes, as shown in Figure 5. The dubber's explanation can be clarified by adding captions to help the students to understand the subject [15].

Figure 5. Revision process based on suggestions from media expert: (a) before revision, and (b) after revision.

3.4 Disseminate
According to the advice from content experts and media experts, the video was revised and had a final duration of 7 minutes 21 seconds and 8 minutes 57 seconds, respectively, for fat-soluble vitamins and
water-soluble vitamins. Users then carried out the video feasibility assessment. Table 3 shows the feasibility assessment result.

| Aspect   | Feasibility | Category   |
|----------|-------------|------------|
| Learning | 89.9 %      | Very suitable |
| Content  | 91.3 %      | Very suitable |
| Media    | 86.0 %      | Very suitable |
| Benefit  | 90.8 %      | Very suitable |
| Usage    | 89.3 %      | Very suitable |
| Total    | 89.7 %      | Very suitable |

Users’ media aspect assessment was 91.3%, which was lower than that of media experts of 95.5%. The users were Generation Z, while media experts were Generation X. Generation Z has a higher standard of audio-visual quality on video than the previous generation [4]. They might equate the quality standards of video clips or films with instructional videos. However, those differences were not a fundamental problem because the content quality in learning videos was more important than media quality [13]. One user scored 2 (unsuitable) about the video duration because the video was considered long. The video duration of 10-15 minutes was selected because it suited the characteristics of current students [9]. The duration of the vitamin videos has followed these standards, so revisions to the video duration were not carried out.

This whiteboard animation video was declared suitable for use as a learning medium after a feasibility examination by content experts, media experts, and users. This animation video made it easier for teachers to deliver learning materials and contributed to variety to learning media. This video was able to arouse students’ interest in learning. The video was then distributed on YouTube, especially on the Boga UNY channel with the address https://youtu.be/Xe5Dzi9OaI and https://youtu.be/hbAsWnHok-Q, because YouTube has more exciting features and better quality [16].

4. Conclusion
Whiteboard animation videos for vitamins were divided into two parts, namely fat-soluble vitamins and water-soluble vitamins. The first video consisted of the definition, function, characteristic, and classification of fat-soluble vitamins and water-soluble vitamins and an explanation of vitamins A, D, E, and K, which included benefits, functions, and effects of deficiency/hypervitaminosis, sources, and RDV. The second video explained the types of vitamin B complexes, the benefits, functions, effect of deficiency/hypervitaminosis, sources, and RDV of vitamin B complexes and C. This animation used color images with bold colors and without gradations. Each scene began with an animation of hand movements when drawing a sketch and coloring the sketch. The final image appeared in the scene in the last 5 seconds of each scene. This whiteboard animation video combined animated color images, text captions, dubber voices, and back sounds to improve student understanding and maintain student engagement. The feasibility assessment of the video by content experts, media expert, and users showed a score of 89.9%, 96.7%, and 89.7%, so this whiteboard animation video was very suitable for use as a learning medium for Nutrition Science in culinary vocational schools.

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