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Development of A Tutorial Video on the Application of Centrifugal Chromatography for the Separation of Fractions from Campnosperma Auriculatum Root Extract

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ABSTRACT

The purpose of this research is to determine the feasibility of a tutorial video on fraction separation using centrifugal chromatography. The tutorial video of fraction separation using chromatography was made to document the stages of using centrifugal chromatography in separating fractions of white stretched root extract. The separated fraction is derived from the root extract of the *Campnosperma auriculatum*. The research method used is development method, which involves applying the ADDIE model at the ADD stage. The research instrument used is a feasibility assessment sheet on media and material aspects and data analysis using a Likert scale. The data collection technique used was indirect communication with a questionnaire in the form of a questionnaire and validation sheet. The feasibility of video tutorials was assessed by two material experts and two media experts. This study focuses on a video tutorial on centrifugal chromatography-based fraction separation. The final results of the assessment showed that both the material and media aspects received a score of 100%. Thus, it can be concluded that a video tutorial on fraction separation using centrifugal chromatography is very feasible. This video tutorial is expected to be an educational reference for researchers and students in learning fraction separation techniques using centrifugal chromatography.

INTRODUCTION

Separation techniques are various ways to separate components in a mixture. There are many methods that can be used, depending on the type of mixture and the components to be separated. Some commonly used separation techniques include filtration, centrifugation, distillation, chromatography, sublimation, and extraction (Harris, 2007). Some types of chemical separation techniques are chromatography, extraction, filtration, and centrifugation. Chromatography techniques separate things selectively by using the different ways that the mixture interacts with the stationary and mobile phases (Poole, 2003). One of the chromatographic techniques that can be used is centrifugal chromatography. Centrifugal chromatography is a chromatographic technique that combines the principles of centrifugation and chromatography for efficient separation (Hostettmann et al., 1995). This technique is effectively used in separating secondary metabolite compounds from various natural sources (Hammerschick & Vetter, 2022)

The survey was conducted on 46 students in the chemistry education study program at FKIP Tanjungpura University, batches 2021 and 2022. There were four questions in the survey. The data indicates that students have never been introduced to the topic of separation techniques using centrifugal chromatography and its application in fractionation. 65.2% of students stated that they did not know centrifugal chromatography. 82.6% of students did not understand the working concept of centrifugal chromatography. 84.8% of students had never

used centrifugal chromatography. 82.6% of students did not know the existence of centrifugal chromatography in the chemistry education laboratory of FKIP Tanjungpura University. In addition to the quantitative data, students also conveyed various views and obstacles they experienced regarding learning about centrifugal chromatography. Several students felt that the concept of this technique was difficult to understand because during the lecture it had never been explained in detail, both in terms of theory and practice. They also expressed a lack of confidence in using the tool because they had never seen firsthand how it works or how to operate it. The minimal use of visual or video-based learning media and limited laboratory practice were factors that reinforced their difficulty in understanding this material thoroughly.

The survey results indicate a lack of knowledge and experience in centrifugal chromatography. Based on the analysis of learning in chemical separation courses and the chemistry of natural materials, this topic was found not to be the main study. This separation technique can be used to separate secondary metabolite compounds, and students can use it directly due to the availability of centrifugal chromatography instruments in the chemistry education study program laboratory. So, students should be taught centrifugal chromatography techniques and how to use them to separate fractions so that they can learn more about and get better at using centrifugal chromatography to separate fractions from natural extracts to get secondary metabolite compounds.

Education uses technology as a tool in the learning process (Dwi Cahyani & Gusman, 2023; Salsabila & Agustian, 2024). Learning media is an important element that needs to be considered by educators in the teaching process. The main function of learning media is to help students understand the material, increase learning motivation, and maintain the effectiveness and efficiency of learning through the scientific approach contained in the media (Apriani et al., 2021; Haryoko, 2017). Media plays a crucial role in conveying information during the learning process. Thus, media can be considered one of the main components of learning.

Media aids students in comprehending the provided material and enhances their appeal (Ersando et al., 2022). A pre-research survey revealed that 60.9% of students prefer digital learning. Digital learning devices can be in the form of e-modules, videos, and student worksheets (Herlina et al., 2022; Kahar et al., 2021). Of the several forms of learning devices above, 76.1% of student respondents chose video as their preferred learning device. Video tutorials on the use of centrifugal chromatography in separating fractions are very minimal on the YouTube platform. Videos uploaded on the YouTube platform in Indonesian mostly only contain an introduction to the tool and its benefits but do not contain an explanation of the use of centrifugal chromatography in separating fractions. This makes video tutorials a suitable medium or learning tool. The advantage of video media is that it contains a display that attracts attention and can focus student learning concentration (Mandalika & Syahril, 2020; Rasyid et al., 2022). Video media has specific characteristics compared to other media so it is widely used as a learning tool. Compared to narrative e-module media and worksheets that only contain questions, this video can be used by students to study independently flexibly while directly observing the process and use of centrifugal chromatography. This learning video can also be arranged with additional narration, animation, background music, and emphasis on important steps, so that it can attract students' interest in learning more effectively than material in the form of long texts or collections of questions. Such as the combination of audio and visual, the ability to attract attention, and the ability of dynamic visualization. Video can attract more attention despite its short duration (Chandra & Nugroho, 2017; Monitasari et al., 2019). Furthermore, numerous techniques and terminology the in centrifugal chromatography technique are challenging to articulate verbally. Consequently, video serves a superior medium for illustrating these techniques rather than an e-module or worksheet.

In the video tutorial on fraction separation using centrifugal chromatography, the fraction separated is the fraction of the fractionation results from the root extract of Terentang putih. Terentang putih, *Campnosperma auriculatum*, is a plant of the Anacardiaceae family that is commonly found in swampy tropical rainforests (Lisdayanti et al., 2016). White stretched shama are commonly found in primary peat swamp forests in West Kalimantan.

Traditionally, the stem of this plant is used as a breeding medium for woodworms (tambelo) in West Sumatra (Salembeheu et al., 2022). The root part of this plant can also treat headaches (Ismail et al., 2015). Apart from being a traditional medicine, *C. auriculatum* is also used in the industrial field. The wood of *C. auriculatum* is used as raw material for pulp or paper making(Novriyanti et al., 2014) and a basic material for making furniture (Sabran et al., 2016). The fruit seeds and sap of this plant can also produce oil (Heyne, 1988).

Previous phytochemical study on *C. auriculatum* root extract showed the presence of secondary metabolite compounds including phenolics, alkaloids, and steroids (Muharini et al., 2024). This plant was reported to have anti-microbial activity (Sanusi et al., 2018). The stems and roots have strong anti-termite, antioxidant and cytotoxic properties (Muharini et al., 2024). Hitherto, there has been no previous research that specifically uses centrifugal chromatography techniques for the separation of fractions from *C. auriculatum* root extract. In addition, there is no learning media in the form of Indonesian language video tutorials that explain the procedure for using the technique in separating fractions. This shows a gap in research that this research aims to bridge, as well as being the basis for innovation in the development of video-based learning media. This paper describes the making of a tutorial video on the use of centrifugal chromatography for separation of *C. auriculatum* root extract. It is suitable for use by students of the Chemistry Education Study Program at FKIP Tanjungpura University and students in general.

METHODS

Research Design

The method used in this research was research and development (R & D). The development model used the ADDIE model *(Analysis, Design, Development, Implementation, Evaluation*). The ADDIE model can be applied to design various products, including learning models or devices and teaching materials(Muliani et al., 2019). However, this research only includes three initial stages, namely analysis, design, dan development. At the analysis stage, the method used is qualitative analysis, which is an analysis method carried out by interview and observation (Junaid, 2016). Interviews were conducted with lecturers teaching chemical separation courses in indirect communication via short message. The survey was conducted by sending a questionnaire in the form of a questionnaire regarding centrifugal chromatography to 46 students of the Chemistry Education Study Program, FKIP, Tanjungpura University class of 2021 and 2022. At the design stage, the media design is compiled in the form of a storyboard, determining the format for making video tutorials and then compiling an expert validation sheet(Aisyah et al., 2021). Then at the development stage, the media that has been designed is realized, and an assessment of its feasibility is carried out (Ardiansyah et al., 2023)

Research Target

Validators in this study were media and material experts who were lecturers in the Chemistry Education Study Program at FKIP Tanjungpura University to conduct a feasibility assessment of the tutorial video developed. Validation was carried out by 2 material validators and 2 media validators

Research Data

The data obtained in this study are quantitative data in the form of assessment data on the validation sheet of material and media experts on the feasibility of tutorial video on fraction separation using centrifugal chromatography. The study also collected qualitative data, which took the form of suggestions provided by material experts and media experts in the comments column on the validation sheet

Research Instruments

The instrument used is a feasibility test sheet or material expert validation and media expert validation. Material and media expert validation sheets used previously have gone through the instrument feasibility test. The validation sheet for material expert consists of 2 aspects of assessment, namely the feasibility of content quality and the feasibility of presentation techniques. The validation sheet for media expert consists of 3 aspects of assessment, namely the feasibility of graphics, the feasibility of performance, and the feasibility of text /typography readability.

Data Analysis

Data collection uses indirect communication techniques by providing media expert and material expert validation sheets to respondents and data analysis using a Likert scale. Likert scale references are set with scores of Strongly Agree (5), Agree (4), Moderately Agree (3), Disagree (2), and Strongly Disagree (1). The validation sheets of material experts and media experts were filled in by respondents and scores were obtained to calculate percentages.

$$\text{Percentage} = \frac{\text{number of scores obtained}}{\text{maximum score}} \text{x}100\%$$

The percentage data from the feasibility test results from media experts and material experts are then used to draw conclusions based on the assessment aspects that have been studied with the assessment categories in table 1.

Table 1. Validating rating category

Percentage	Category
0%-20%	Very Unfeasible
21%-40%	Not Feasible
41%-60%	Moderately Feasible
61%-80%	Feasible
81%-100%	Very Feasible

(Asyhari & Silvia, 2016)

RESULTS AND DISCUSSION

The analysis stage is carried out by identifying the causes of performance gaps in the field, determining instructional objectives, confirming the target audience, determining the resources needed, determining potential systems, and compiling projects (Branch, 2009). The development of tutorial video in this study used the ADDIE model. In this case, the ADDIE model was applied in the analysis, design, and development section. The tutorial video created is a tutorial video on fraction separation using centrifugal chromatograph, a typical deliverable for the development phase is all Learning Resources for the entire ADDIE process (Branch, 2009). The results of making this video tutorial are described as follows:

a. Analysis

The analysis stage is carried out by analyzing the need for making video tutorials on the

use of centrifugal chromatography in separating a fraction. The analysis was carried out in pre-research by giving several questions to respondents, namely students of the Chemistry Education Study Program batches 2021 and 2022. There were 6 questions asked with four questions about centrifugal chromatography and two questions about learning tools or media. The investigation revealed that 65.2% of the 46 students surveyed indicated unfamiliarity with centrifugal chromatography. 82.6% stated that they did not comprehend the working concept of centrifugal chromatography. 84.8% stated that they had never used centrifugal chromatography. 82.6% did not know the existence of centrifugal chromatography in the laboratory of the Chemistry Education Study Program at FKIP Tanjungpura University. Thus, it indicated a lack of student knowledge about centrifugal chromatography.

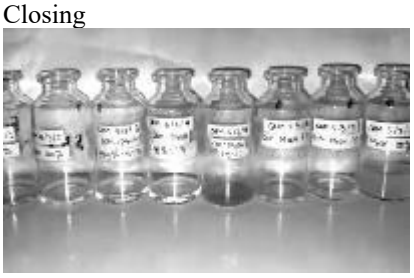
The needs analysis was also carried out by analyzing the existence of video tutorials on centrifugal chromatography in Indonesian on the *Youtube* page. Based on the analysis, video tutorials on the use of centrifugal chromatography in separating fractions are very minimal. The videos found on the YouTube page have a low resolution so that the steps displayed are less clear, do not focus on one object, and one of the videos was full of words so it looks boring. This encourages the creation of video tutorials that are clearer and less boring. The selection of video tutorials was also based on the results of pre-research to students, which showed that out of 46 students 60.9% chose digital learning devices as the learning device needed in understanding centrifugal chromatography. 76.1% liked the video as the preferred learning media because it could be more easily understood.

b. Design

The design stage was carried out by making a media design in the form of a storyboard that contains the design of the cover, content, language use, and appearance in the video. After that, a video script was made in the form of a sentence arrangement used to open, convey the steps, and close the video. Tools,materials, and elements for video shooting, including transition effects, images, emoticons, and background music, were prepared. The design stage was also carried out by compiling material and media validation sheets.

Tabel 2. Story board video tutorial fractionation using centrifugal chromatography

No	Part	Figures	Detail
1.	Distribution media		Via personal youtube account
2.	Front Cover		Contain video title, font type Berlin sans and font size 26 dan ukuran tulisan 26, font color maroon, bold, with cream as background color.
3.	Substance	Introduction  Tools and Materials	• Introduction: greetings, self-introduction, mention the name of institution, tutorial video purposes • Describing plant sample preparation, tools and material used for fractionation using centrifugal chromatography.

		 Fractionation  Closing 	• Showing how to prepare C. auriculatum root extract for centrifugal chromatography. • Explaining and showing how to prepare the plate used as stationary phase. • Explaining and showing how to install plate to rotor, to insert eluent typ used on to plate. • Explaining and showing how to start the fractionation using centrifugal chromatography. • Showing and explaining how to observe spots or separation occured on the plate using UV lamp, how to increase the eluent system, and how to collect fractionation result using vials. • Closing statement, showing the fractionation result, and saying thank you to audience • Video duration 6-7 minutes
4.	Languaged used		Indonesian

c. Development

At this stage, the process of creating a video tutorial on fraction separation using centrifugal chromatography begins with shooting in accordance with the previously designed scenario. Here, the steps are shown clearly and in detail. Each stage is carefully recorded, from preparing materials and tools to setting up the centrifuges and separating the fractions, to ensure that the audience can follow along easily.

After the shooting, the next step was video editing using the paid editing apps *Capcut* and *Inshot*. At this stage, the footage that has been recorded was organized, cut, and given a narration that explains each procedure performed. Visual effects such as graphics or animation are also added. Editing was done with a focus on presenting clear, precise, and interesting information so that the audience can easily follow the process of separating fractions using centrifugal chromatography. The use of text, visual indicators and supporting sounds will be added to clarify each step, ensuring that the audience understands every detail in the experiment. In addition, aesthetics and readability were also a major concern, so that the resulting video was not only informative, but also visually appealing. Video Tutorial on Fraction Separation using Centrifugal Chromatogaphy can be seen on Figure 1.

(a) (b) (c)

Figure 1. Screenshot of tutorial video on fraction separation using centrifugal chromatography: a) Front view (cover) of the tutorial video, b) Content view of the tutorial video, c) Tools used

for the research

In the development stage, after the product was realized, the feasibility assessment stage is then carried out and revisions are made based on the results obtained. Feasibility assessment is carried out based on media and material aspects. The feasibility assessment determines whether media can be uploaded and used by the public. Experts in their fields carried out the feasibility assessment. The results of the assessment of the two aspects obtained very feasible results with a percentage of 100% on both aspects (Figure 3).

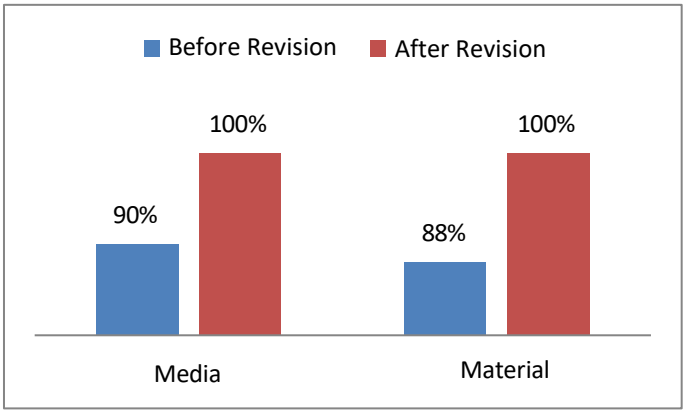


Figure 3. Percentage of feasibility of video tutorials on fraction separation using centrifugal chromatography

The discussion of the results of the feasibility assessment of each aspect will be described as follows.

a. Feasibility of Material Aspects

The material developed in this video tutorial includes synchronization steps using centrifugal chromatography. The video is arranged systematically starting from the presentation of the tools and materials used, the presentation of the formula for making silica plates in centrifugal chromatography, sample preparation, operation of the chromatography tool and collection of the resulting fractions. In addition, practical procedures are also provided including the use of personal protective equipment, the use of other laboratory equipment and the selection of solvents. The delivery of the material is accompanied by narration, animation, and highlights at each important step to facilitate student understanding. Thus, the video not only provides a procedural overview, but also emphasizes the understanding of the basic concepts of certain techniques.

The material aspect feasibility assessment was carried out by two experts in their fields, namely experts in chemical separation courses. The results of the feasibility assessment on the material aspects carried out on experts can be seen in Table 3.

Table 3. Results of Material Aspect Feasibility Assessment

Indicator	Percentage (%)	Category
Suitability of Material	100%	Very Feasible
Accuracy of Material	100%	Very Feasible
Material collapse	100%	Very Feasible

Based on the material aspect, the feasibility assessment of the Video Tutorial for Fraction

Separation using Centrifugal Chromatography is reviewed from various indicators including the suitability of the material. Based on the material aspect, the video tutorial made already contains the steps of using centrifugal chromatography appropriately. In the material accuracy indicator, there is an evaluation in the table provided. The results of the revision of the table presented can be seen in Figure 3. The concept section is clarified with a sequence of delivery of material tools, assembly, sample preparation, separation and final results. In addition, the definitions, terms, images, separation steps and materials used are accurate and score 4 (agree). Based on the indicators of the sequence of material, the material in the video is presented coherently and systematically and obtained a score of 4 (agree). Specific, integrated and coherent material can make it easier for students to understand the material and measure the level of learning success(Najamuddin et al., 2021).

(a)Before revision (b)After revision

Figure 4. Result on Video Tutorial: (a)Before revision, (b)After revision

b. Media Aspect

The feasibility assessment of the media aspect was carried out by two experts in their fields. Aspects are measured based on several indicators. The results of the feasibility assessment on the media aspects conducted by experts can be seen in Table 4.

Table 4. Media aspect feasibility assessment results

Indicator	Percentage (%)	Category
Visual Media	100%	Very Feasible
Audio Media	100%	Very Feasible
Suitability of Duration	100%	Very Feasible
Display Quality	100%	Very Feasible
Ease of Operation	100%	Very Feasible
Writing	100%	Very Feasible
Authorship	100%	Very Feasible

Assessment of the media aspects of the Video Tutorial on Fraction Separation using Centrifugal Chromatography is based on several indicators. In the visual media indicator, the video design as a learning media gets an evaluation because of the lack of audio and dominant writing so it is a little boring. But the color selection used is harmonious and the placement of the text does not interfere with the display. The images and tables presented are also clear, neat and proportional in size. The balance of image color with media is an assessment that must be considered by multimedia learning media in order to provide an attraction for those who see the media (Kusuma et al., 2015). Images that have good quality will clearly make students better understand the meaning of the material presented.

Based on the visual media indicators, the audio narrator of the tutorial video must be added. A clear narrator's voice can help in understanding the meaning conveyed (Ahdiyah et al., 2015). The revised addition of the audio narrator to the video can be seen in Figure 4. The

background music sound also does not interfere with the narrator's voice and fits the atmosphere. In the duration suitability indicator, the duration of the tutorial video is not too short and not too long or as needed. The display quality indicator found that the video tutorial display was *high definition* (HD), not blurry and not broken.

Indicators of ease of operation obtained that playback and use of video tutorials are easy and do not complicate students in opening them. In the writing and authorship indicators, the font type, font size, font variation, and font color are appropriate and contrast with the background. The writing presented is also easy to read and written using standard words and according to PUEBI rules.

Judging from the aspects presented, based on the assessment carried out by experts, the video tutorial on fraction separation using centrifugal chromatography has met the eligibility criteria both in terms of material and media. This video can help students as a learning medium in increasing their knowledge of centrifugal chromatography. Thus, this video tutorial not only functions as a complement to practicums, but also as an effective and interesting independent learning medium for use in learning analytical chemistry or chemical separation. The video tutorial on fraction separation using centrifugal chromatography can also be uploaded to the YouTube page as a reference for students or viewers who need it.

CONCLUSION AND RECOMMENDATIONS

This research concluded that the tutorial video on fraction separation using centrifugal chromatography developed was highly feasible. Thus, video products can be used as a supplement to enhance learning in chemical separation courses. This innovative approach not only aids in understanding the operational principles of centrifugal chromatography but also engages students in a more interactive learning experience. Nevertheless, additional research and development are needed to create a more effective video product that meets students' expectations. Further research can use other natural materials available in the area as potential that can be utilized in learning.

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