***JKPK (JURNAL KIMIA DAN PENDIDIKAN KIMIA)**, Vol. 9, No.2, 2024* *pp. 338-354*
Chemistry Education Study Program, Universitas Sebelas Maret *ISSN 2503-4146*
https://jurnal.uns.ac.id/jkpk *ISSN 2503-4154 (online)*

ANALYSIS OF CHEMISTRY PODCAST IMPLEMENTATION IN LEARNING HYDROCARBONS AND PETROLEUM FOR INCLUSIVE STUDENTS

Pingki Wahyu Septianing[1,*] Sulistyo Saputro[1], Lina Mahardiani[1], Nurma Yunita Indriyanti[1], Icha Desti[2]

[1]Master Program of Chemistry Education, Faculty of Teacher Training and Education, Universitas Sebelas Maret, Surakarta, Indonesia
[2]Master Program of Science Education, Faculty of Teacher Training and Education, Universitas Sebelas Maret, Surakarta, Indonesia

ARTICLE INFO

Keywords:
Podcast;
Anchor;
complementary media;
hydrocarbon;
petroleum

Article History:
Received: 2024-06-15
Accepted: 2024-08-08
Published: 2024-08-13
*d*oi:10.20961/jkpk.v9i2.88340

ABSTRACT

This research aims to conduct a feasibility analysis of a chemistry podcast, referred to here as “PodChem,” and to examine the impact of PodChem on learning hydrocarbons and petroleum. This study employs a pre-experimental method. The podcast media were developed using Anchor software and evaluated through a survey using a podcast media assessment questionnaire. The evaluation was carried out by lecturers as validators and students as podcast users. The assessed aspects include content, functionality, and appearance as complementary media in learning hydrocarbons and petroleum. The results indicate that the chemistry podcast PodChem was successfully produced using Anchor software. The findings suggest that PodChem is valid and suitable for educational use. The audio quality produced using Anchor is clear, and its accessibility is broad. Additionally, students reported that the content is relevant and enhances their understanding of the subject matter. Most students also found the podcast to be easily accessible and effective in conveying the concept. In terms of appearance, students agreed that the podcast title is engaging, the delivery is captivating, and the duration is appropriate. The implementation of PodChem in chemistry learning received positive feedback from students, with the majority accepting the use of podcast media in the classroom. Furthermore, 88.9% of respondents expressed a desire for podcasts to be used as complementary media in future learning, as they found podcasts to be more interesting, insightful, and easy to understand. These conclusions are supported by the results of student questionnaires and the assessment of assignments conducted by teachers in class.

**Corresponding Author Email:* sulistyo_s@staff.uns.ac.id
How to cite: P. W. Septianing, S. Saputro, L. Mahardiani, N. Y. Indriyanti, I. Desti, " Analysis of Chemistry Podcast Implementation in Learning Hydrocarbons and Petroleum for Inclusive Students " *Jurnal Kimia dan Pendidikan Kimia (JKPK)*, vol. 9, no. 2, pp. 338-354, 2024. Available: http://dx.doi.org/10.20961/jkpk.v9i2.88340.

INTRODUCTION

The COVID-19 pandemic has profoundly impacted education, exposing significant vulnerabilities in educational systems worldwide. Despite government efforts to mitigate learning loss through implementing curriculum adjustments for educational institutions under special conditions, these measures have proven inadequate in fully addressing the educational setbacks incurred during this period [1]. A critical challenge remains the need for more guidance provided to teachers in developing effective distance learning concepts, which underscores the need for substantial improvements in this area.

In response to these challenges, the Indonesian Minister of Education and Culture introduced the "Merdeka Curriculum" to revitalise the education system [1]. Addressing learning loss requires a multifaceted approach, including enhancing access to technology, creating high-quality educational content, training teachers in using distance learning tools, adopting inclusive education practices to engage all students, and closely monitoring students' learning progress.

The Merdeka Curriculum represents a new educational framework in Indonesia, designed to improve the quality of learning by making it more student-centered. This curriculum seeks to cultivate lifelong learners by prioritising depth over speed, allowing students to explore concepts and strengthen competencies at their own pace. It also emphasises project-based learning and grants teachers the flexibility to select teaching tools that best meet the needs and interests of their students [2-4]. However, within this framework, the quality of teaching and learning processes in inclusive education has often received lower priority [5].

Inclusion in education refers to integrating students with disabilities or special needs into general education classrooms. This approach requires careful assessment of each student's needs and implementing strategies to support them within the classroom setting. Key strategies include teacher training, team teaching, and classroom accommodations. Alternative media have been proposed to support differentiated learning based on student learning styles, including YouTube, multimedia presentations, audio recordings, podcasts, music, role-playing, and simulations [7-10].

Podcasts offer several advantages over other forms of media, particularly in educational contexts. They provide direct access to expert knowledge, making them an invaluable tool for learning. The typically short duration of podcasts is especially well-suited for use as a learning medium in inclusive education, where concise and focused content can benefit students who face challenges in traditional learning environments. Examples of educational podcasts that support inclusive education include "Think Inclusive" and the "Inclusive Education Project (IEP) Podcast."

Podcasts offer flexibility in delivering curriculum content, accommodating various learning styles, and providing access to educational content anytime and anywhere. Recent research indicates that podcasts can significantly increase student engagement

and broaden access to knowledge [8]. Therefore, integrating podcasts into the educational framework represents an innovative solution to support the implementation of the Merdeka Curriculum, which aims to be more adaptive and relevant to diverse learning needs.

The subject of chemistry presents unique challenges in the educational process due to the abstract, complex, and tiered nature of its concepts, which progress from simple to advanced levels [9]. Teaching chemistry effectively requires addressing these complexities and adopting more dynamic and engaging approaches to foster deep understanding. Innovative teaching methods like podcasts provide a relevant solution to these challenges.

Podcasts enhance the interactivity and accessibility of chemistry education, catering to students with different learning styles. They also create opportunities for collaborative learning, which can increase student engagement in the chemistry learning process. Digital media like podcasts have improved students' understanding and interest in chemistry topics [10]. Consequently, implementing innovative teaching methods, including podcasts, is crucial for improving the effectiveness of chemistry instruction.

The term "podcast" originates from the combination of "iPod" and "broadcasting" [11]. Podcasts enhance listeners' creativity and imagination as an audio medium akin to radio. They are time-efficient and support multitasking, allowing students to engage with educational content while travelling, jogging, or performing other activities.

Previous research titled “Students' Perception Towards Learning Literature Through Podcasts” demonstrated that students have a positive attitude toward using web-based podcasts in literature learning. The study found that 90% of participants agreed that learning through podcasts was productive, and more than 80% reported that podcasts increased their motivation to study literature [12].

Research indicates that the largest podcast audience comprises Millennials and Generation Z. Studies have shown that at least a third of Millennials listen to podcasts daily. At the same time, 75% of Generation Z have access to paid podcast services [13][14]. Generation Z, born from the mid-1990s to the early 2010s, includes many individuals in their teenage to early adult years, such as high school students. Consequently, this research targets high school students as its primary audience. Information and Communication Technology (ICT) tools, such as podcasts, have opened new possibilities for educational purposes [15]. Digital media, including podcasts, has enhanced student engagement, facilitated a deeper understanding of learning content, and supported more effective and relevant education in the digital era [10].

Podcasts offer educators a creative platform to expand knowledge and provide novel learning experiences for students. They help students grasp specific and important topics and benefit slow and auditory learners. Additionally, podcasts create a private practice experience, generating a sense of personal space. When listeners use headphones, they make sound bubbles

around themselves, enabling a form of 'sensor gating' and establishing 'mobile territory' [16][17]. Podcasts are also widely used as authentic classroom listening [18], motivating students to listen actively [19].

Many pedagogical studies have employed podcasts to increase classroom engagement, recognising them as a unique educational platform. Like radio talk shows, podcasts are audio recordings that capture discussions on various topics, including those under study [20]. As a new face of educational media delivery, podcasts refer to subscription-based and downloadable audio programs. They can be accessed using various digital devices, such as desktop computers, laptops, smartphones, and MP3 players [21][22]. Podcasts bring audio content to their audience, accessible repeatedly across multiple platforms, including Spotify, Anchor, Apple Podcasts, and Overcast. Moreover, podcasts present a viable alternative for educators as a learning medium due to their ease of production and the simplicity of required tools, often smartphones.

Despite the growing popularity of podcasts, chemistry-related podcasts still need to be explored. A review of a series of science podcasts revealed that only 3% focused on chemistry, compared to 18% on physics and astronomy and 13% on biology [23]. Given this context, the present research aims to contribute to the field by providing references for using podcasts as a learning medium. This study, titled "Analysis of the Implementation of Chemistry Podcasts in Teaching Hydrocarbons and Petroleum," seeks to describe the application of chemistry podcasts in teaching hydrocarbon and petroleum topics and to analyse their effectiveness in educational settings.

METHODS

1. Research Design

This study employed a pre-experimental design, a research approach often utilised to preliminarily assess the effects of a treatment or intervention before committing to a full-scale experiment. Pre-experimental designs involve observing the outcomes of a single or multiple groups following a treatment; however, they lack a comparison or control group. A control group is necessary to attribute observed changes directly to the intervention, making it difficult to determine the significance of the results with high confidence [24]. Despite these limitations, pre-experimental designs are valuable for exploring the feasibility of an intervention and identifying potential relationships between variables, which can inform the development of more rigorous experimental designs in subsequent research. This study's pre-experimental design was chosen because it allows researchers to conduct preliminary investigations, gather initial insights, and explore the potential impact of the podcast intervention on students' understanding of chemistry before considering more complex and resource-intensive experimental methodologies.

2. Participants

The participants in this study comprised nine high school students: two male students and seven female students.

The research began with a preliminary study to gather detailed information about the chemistry curriculum and teaching methods currently used at a high school that follows an inclusive education model. This high school was selected because it has small classes, with Class A consisting of only two students and Class B comprising seven students. The preliminary study involved discussions with the chemistry teachers and an analysis of the current instructional practices and challenges associated with teaching chemistry in this setting.

After obtaining this foundational information, the researchers coordinated with the chemistry teachers of Classes A and B to plan the implementation of podcasts as a supplementary tool in chemistry instruction. The partner teacher selected for this study was the regular chemistry instructor for these classes, chosen for their familiarity with the student's learning needs and their existing teaching practices. The role of the partner teacher was multifaceted: they served as a mediator in delivering the podcast content to the students, observed and recorded the students' responses to the podcasts, assigned tasks related to the podcast content, and assessed the students' understanding of the concept.

The involvement of the partner teacher was crucial to the study, as it ensured that the podcast intervention was integrated into the existing curriculum in a manner that was both practical and aligned with the student's learning needs. Additionally, the partner teacher's observations and assessments provided valuable qualitative data on how the students engaged with the podcast content, contributing to the overall evaluation of the podcast's effectiveness as a learning tool in this inclusive high school setting.

3. Data Analysis

The next stage involved compiling a podcast script of three episodes focused on fossil fuels. The scriptwriting process began by analysing the content in the students' textbooks. The initial script was then revised by teachers to condense the content and focus on essential topics relevant to student's everyday lives, ensuring it was appropriately tailored to their abilities. Lecturers and teachers subsequently validated the podcast script. The validation criteria included aligning the podcast content with the Grade XI chemistry curriculum, the clarity of pronunciation, the tone of the sentences, and the appropriate duration of each podcast episode.

Following validation, the recording process commenced. The researchers used the Anchor application on smartphones to record the podcasts. Anchor is a highly beneficial tool for beginner and intermediate podcasters, offering an all-in-one solution for recording, editing, distribution, and podcast analytics. While there may be some limitations, particularly in advanced editing capabilities, users can overcome these challenges by utilising additional software. Anchor simplifies the podcasting process, allowing creators to focus on producing engaging and high-quality content.

Table 1. Podcast Media Assessment Questionnaire Grid

No.	Aspect	Indicator	
1	Content	1.1	The content of the Chemistry Podcast is consistent with the theme conveyed by the teacher.
		1.2	The contents of the Chemistry Podcast are already relevant to fossil fuels.
		1.3	Chemistry podcasts can provide additional information beyond the textbook.
		1.4	The Chemistry Podcast can increase understanding regarding Fossil Fuels
		1.5	The contents of the Chemistry Podcast are clear and objective.
2	Functionality	2.1	The chemistry podcast is easy to access
		2.2	The opening of the Chemistry Podcast caught my attention.
		2.3	The language used in the Chemistry Podcast is based on the content.
		2.4	Chemistry Podcast can convey concepts well.
		2.5	The sound recording on the Chemistry Podcast is self-explanatory.
		2.6	The storyline on the Chemistry Podcast has helped me understand the content.
3	Podcast Appearances	3.1	I am interested in the Chemistry Podcast Title presented
		3.2	The title of the Chemistry Podcast is appropriate and consistent with its content.
		3.3	The duration of the Chemistry Podcast is enough to give me knowledge about the topic being discussed.
		3.4	The presented content can encourage me to convey knowledge about the discussed topic.
		3.5	I am impressed and interested in listening to Chemistry Podcast until the end.
		3.6	The delivery of the Chemistry Podcast has been interesting.

(Source: adapted from Leite et al. 2022)

One challenge encountered during the recording process was background noise, which compromised the clarity of the recordings. To address this issue, choosing the right location and time was necessary to ensure a quiet environment for producing clear, noise-free recordings. The next step was the editing stage, where the intro and outro music or background sound was added. After completing the editing, the podcast's title, description, and episode information were finalised. The audio podcast was then published.

Researchers shared the audio podcasts via links that could be accessed through Google Chrome, making it easier for students who did not have the Anchor application on their phones. Initially, the link was shared with the teacher to verify its accessibility. Once confirmed, the teacher played the podcast in class. The podcast was distributed to students through links sent via the WhatsApp platform. Student engagement was tracked using the analytics the podcast hosting platform provided, which included metrics such as the number of listens.

This research was conducted over three sessions. In each session, the researcher provided a new podcast episode based on the predetermined topic of fossil fuels. The first episode discussed the origins of fossil fuels, the second episode covered

efforts to conserve fossil fuels, and the third episode, presented during the final session, focused on innovations in renewable energy. As a result of this phase, students were able to explain various alternative energy sources that could replace fossil fuels. The podcast was delivered as a supplementary learning tool alongside face-to-face instruction during implementation. Monitoring to ensure that students listened to and understood the podcast content was carried out through assignments, which the teacher then reviewed.

After the third podcast episode was played, a link to a podcast media assessment was distributed to the students. The podcast media assessment questionnaire was adapted from the research by Leite et al. [25], titled “Construction and Validation of Podcast for Teen Sexual and Reproductive Health Education.” This questionnaire was chosen because of its relevance and proven validity, which helped save research time—the adaptation and validation of the questionnaire involved expert review and feedback. Researchers collected feedback on each question's relevance, clarity, and comprehensiveness, revising them based on the expert input to enhance clarity and relevance. The assessment aspects and indicators were adapted to fit this study's content and target audience. The final draft of the assessment instrument was reviewed by lecturers and revised until it received validation. Below is the podcast media assessment questionnaire grid.

RESULTS AND DISCUSSION

Preparation: Determining the Podcast Name, Topic, Scripting, and Validation

In this study, the podcast was named "PodChem," a name derived from "Podcast Chemistry." The name "PodChem" was chosen for its brevity and easy pronunciation, ensuring students can easily remember it. This choice aligns with previous research, which suggests that the name of a podcast should be familiar and easy to pronounce to enhance memorability [26]. The name "PodChem" is also directly relevant to the topics discussed in each episode, which are all about chemistry.

The selection of the podcast topic was informed by discussions with a chemistry teacher at an inclusive high school, where the chemistry concept being taught in Classes A and B covers hydrocarbons and petroleum. The teacher explained that the instruction was primarily application-oriented, with less emphasis on theoretical depth, to better accommodate the student's needs. Based on these discussions, the topic of fossil fuels was chosen for the podcast.

The podcast created for this study falls under the podcast series category, which refers to several episodes released under a single podcast name [23]. This series, titled "PodChem," consists of three episodes, each designed to fit within the available teaching hours for the topic of hydrocarbons. The episodes are titled: "Fossil Fuels," "Efforts to Save Fossil Fuels," and "Renewable Energy Innovations." These topics were selected based on their relevance and applicability to the student's learning needs, as determined through discussions with the teacher.

The scriptwriting process began by analysing the content in the students' textbooks. The initial script underwent

revisions by the teacher to condense the content and focus on essential, everyday life-related topics suitable for the student's abilities. A lecturer made further revisions to ensure the content was concise yet engaging, allowing it to be effectively presented within a podcast of no more than five minutes. The "PodChem" script was designed to be short, concise, and clear, preventing student boredom and maintaining their interest.

"PodChem" was also integrated with independent assignments to motivate students to listen and maintain sustained attention. After undergoing consultation, revision, and validation stages, the "PodChem" script was finalised and prepared for the recording stage.

Podcast Production: Recording, Editing, and Publishing

The production process for "PodChem" utilised the Anchor application, a popular tool for podcast creation due to its user-friendly interface and extensive features. Anchor offers a variety of sound effects, music inserts, background music, and an editing menu, making it a comprehensive and capable platform for producing podcasts. One of the significant advantages of Anchor is its ability to upload podcasts directly from mobile devices and automatically distribute them across multiple platforms, such as Apple Podcasts, Spotify, and others, with a single upload. Additionally, Anchor provides easy-to-understand statistics on podcast performance, including listener numbers and other metrics, which help podcasters gain insights into their audience.

The recording process for "PodChem" was conducted during quiet periods to ensure high audio quality with minimal background noise. During recording, careful attention was paid to articulation, tempo, volume, and intonation to maintain student engagement with the podcast content. Each episode of "PodChem" was recorded to be approximately three minutes long. PreviouKapiti, H. Akcay and T. De Jong, “Using hands-on and virtual laboratories alone or together which works better for acquiring knowledge and skills,” Journal of Science Education and Technology minutes.

Podcasts exceeding 15 minutes may lead to losing listener attention and decreased comprehension [28]. Studies have shown that students prefer shorter podcasts, which are easier to explore, understand, and listen to in various settings [21]. This aligns with Koppelman's [29] assertion that educational podcasts should be short, lively, and entertaining. Moreover, podcasts should complement classroom instruction rather than serve as a direct substitute, and content should not simply duplicate what is available in textbooks.

The next stage involved editing the recorded audio. This process included adjusting the volume, removing noise, and adding intro music or sound effects. During editing, a recording preview was conducted to check for excessive noise. Re-recording was performed if significant noise was detected and could not be adequately edited out. For minor noise issues, the noise segments were cut during editing. The editing

phase also allowed for adjusting the duration of the podcast to ensure it remained within the desired timeframe. Intro and outro music and background music were added to capture and maintain students' attention, preventing them from becoming disengaged while listening. This approach was based on previous research indicating that the primary drawback of podcast-based audio media is its reliance on sound alone, which can lead to student boredom if not supplemented with music [26].

The final stage was publishing. The publishing process involved filling in key information, including the podcast title, description, and episode details. Once all the information was complete, the podcast audio was published on Anchor and available for listening. In addition to being accessible through the Anchor application, the podcast could be shared via a direct link, allowing it to be played through web browsers like Google Chrome.

Implementation

"PodChem" was implemented as a complementary medium in chemistry learning and designed to support and enhance the concept presented in the classroom. Complementary media are resources that augment the primary teaching concept, reinforcing students' understanding through additional formats. Teaching strategies integrating "PodChem" include the Flipped Classroom, Blended Learning, and Independent Learning approaches.

During the implementation phase, the teacher played " PodChem " in the classroom using a mobile phone connected to a speaker to ensure the audio was audible. While the podcast was played, students listened attentively. To monitor students' understanding, the teacher assigned tasks related to the podcast content and reviewed their assignments. The podcast was typically played 2–3 times in class to reinforce key concepts. Additionally, the podcast was shared in the WhatsApp group in the class, allowing students the flexibility to listen to it again at their convenience. This approach aligns with research by Carvalho, which indicates that students are motivated to repeatedly listen to podcasts to review and understand detailed information [21].

Playing podcasts in class reinforces their role as a complementary medium. Integrating podcasts into the Merdeka Curriculum can enhance student engagement, support more flexible and contextual learning, and promote independent learning in line with the curriculum's principles. Previous research has emphasised that podcasts should not replace classroom instruction but should complement it, enhancing and reinforcing learning [27, 30].

The teacher's instructions during the podcast presentation were, "Listen to the podcast, and note down any important information in your notebook." The classroom environment during the podcast sessions was generally calm, as there were only a few students per class. The students responded positively, showing a willingness to listen attentively. These results are consistent with previous studies indicating that podcast media are well-received by students [31].

After the podcast was played in class, the teacher continued with related topics on

petroleum, non-renewable fuels, or issues not covered in the podcast. Occasionally, the podcast was played after the teacher's explanation. For example, Episode 3, which provided information on renewable energy innovations, was played following the teacher's discussion. "PodChem" was also integrated with independent assignments; after listening to the podcast, students received further instructions from the teacher regarding the tasks mentioned in the podcast. For instance, the teacher would clarify the minimum number of examples students needed to note and ask them to explain the meaning, working principles, and advantages and disadvantages of each renewable energy innovation mentioned. These assignments were designed to motivate students to listen attentively to the podcast and encourage interest in future episodes, fostering sustained engagement.

Podcasts in this context served not only as an informational medium but also as an educational tool that can be accessed anytime and anywhere. The flexibility and accessibility of podcasts are among their greatest strengths compared to other media. Additionally, podcasts represent an innovative way to enrich students' learning experiences [26]. In this study, podcasts did not replace in-class content or textbooks but functioned as a complementary medium to support chemistry learning.

Evaluation

The evaluation of "PodChem" focused on three main aspects: content, functionality, and appearance. The content aspect assessed how well the podcast aligned with the topic presented by the teacher, its relevance to the subject, its ability to provide additional information beyond the chemistry textbook, its effectiveness in enhancing students' understanding, and the clarity and objectivity of the content. The functionality aspect examined the ease of access to the podcast, its ability to capture students' attention, the appropriateness of the language used about the content, the clarity of the audio recordings, and how effectively the podcast's storyline helped students comprehend the concept. The appearance aspect considered the appeal of the podcast title, the alignment of the title with the podcast content, the appropriateness of the podcast's duration, its capacity to maintain student engagement until the end, and the overall delivery of the podcast.

This assessment was conducted by distributing a podcast evaluation questionnaire via Google Forms, which nine respondents completed. The questionnaire utilised a Likert scale of 1-4, where one indicated "strongly disagree," 2 "disagree," 3 "agree," and 4 "strongly agree." Based on the survey results, "PodChem" received positive student responses across all three aspects. In terms of content, students agreed that the podcast was relevant and enhanced their understanding of the concept. Regarding functionality, most students found the podcast easily accessible and effectively conveying the content. From the appearance perspective, students agreed that the podcast title was interesting, the delivery engaging, and the duration appropriate.

The implementation of "PodChem" in chemistry learning was well-received by

students, with the majority accepting the use of podcast media in the classroom. Notably, 88.9% of respondents expressed a desire for podcasts to continue being used as a complementary learning tool in future lessons, citing that podcasts are more interesting, provide additional insight, and are easy to understand. This finding aligns with research conducted by Carvalho, which indicated that students found the use of podcasts in learning interesting and useful [21]. Students exhibited a positive attitude towards using podcasts in their learning, expressing satisfaction with the ease of use and motivation stemming from the engaging content [32].

Following are Figure 1, the results of the Podchem media evaluation based on content.

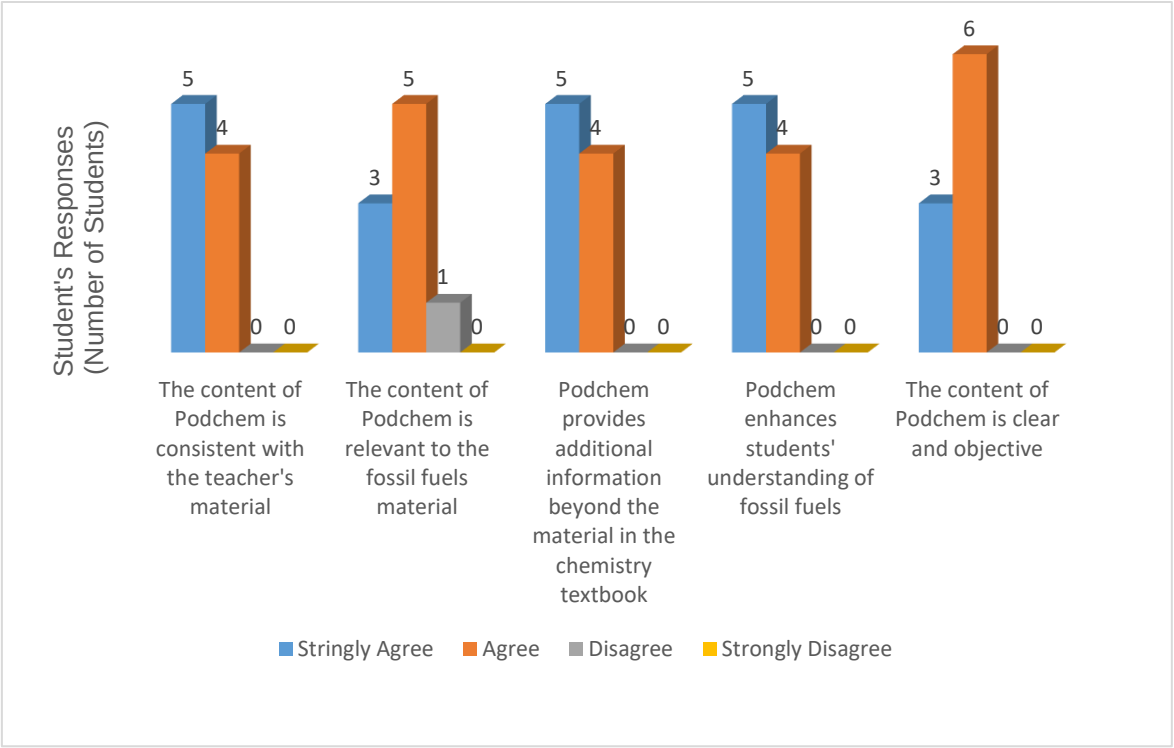

Figure 1. Podcast Media Assessment from the Content Aspect (Source: author's document)

In terms of content, "PodChem" received positive evaluations from students. The majority strongly agreed or agreed that the podcast's content was consistent with the content presented by their teacher and relevant to the topic of fossil fuels. Students also acknowledged that "PodChem" provided additional information beyond what was available in their textbooks, enhancing their understanding of fossil fuels through clear and objective presentations. To ensure this high level of relevance and effectiveness, preliminary studies on the chemistry concept were conducted, along with consultations with teachers to identify topics that podcast media could effectively support and to determine the appropriate timing for content delivery. Based on feedback, there is a recommendation to develop podcasts with

varied content to enhance students' literacy in chemistry further.

Functionality Aspect

In terms of functionality, "PodChem" received favourable evaluations. The result can be seen in Figure 2 below. Most students strongly agreed or agreed that "PodChem" was easy to access, the podcast's opening successfully captured their attention, the language used was appropriate, and the podcast effectively conveyed the content. Additionally, students felt that the sound quality was good and that the storyline helped them understand the concept.

One technical challenge was during the editing process, specifically removing background noise to produce a clear and engaging recording. The ease of access was facilitated by Anchor's sharing features, which allow the podcast to be distributed across various platforms, including Google Chrome. The link could be easily copied and shared via WhatsApp, enabling students who do not have the Anchor app to access the podcast directly through their browser.

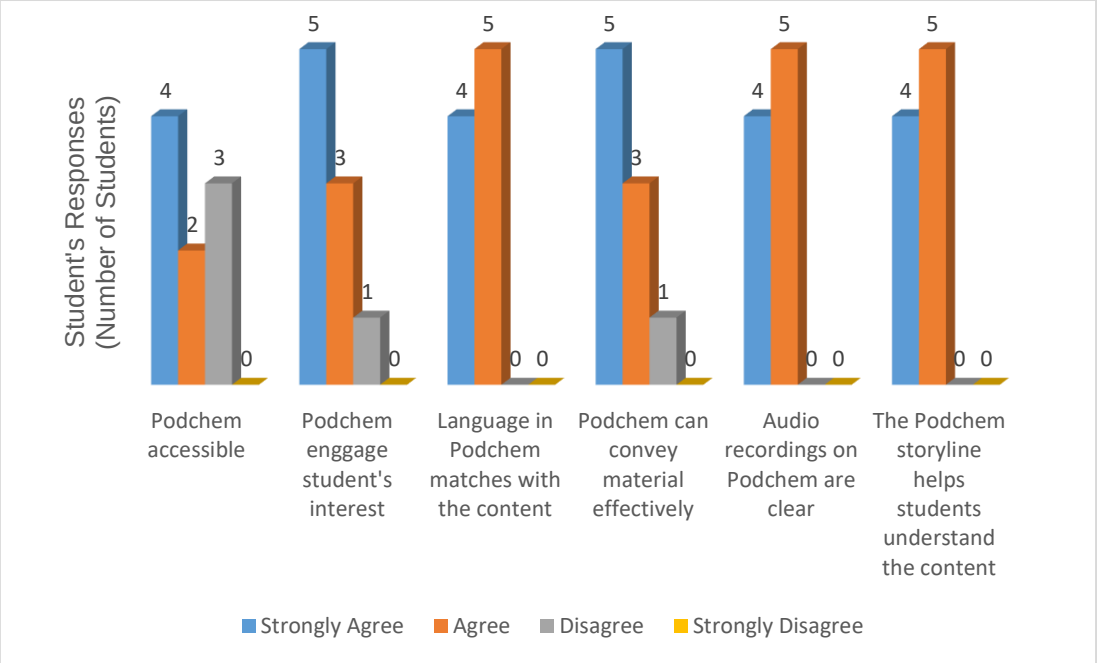

Figure 2. Assessment of Podcast Media from the Functionality Aspect (Source: author's document)

Podcast Appearance Aspects

In terms of podcast appearance, "PodChem" received positive evaluations as shown in the Figure 3 below. Most students strongly agreed or agreed that the title of "PodChem" was interesting and appropriately aligned with its content. They also felt that the duration was sufficient to give them a solid understanding of the discussed concept. The content was presented in a way that encouraged students to engage with and share their knowledge about the topic. Students reported feeling impressed and motivated to listen to the entire podcast, finding the delivery engaging and the overall presentation well-balanced.

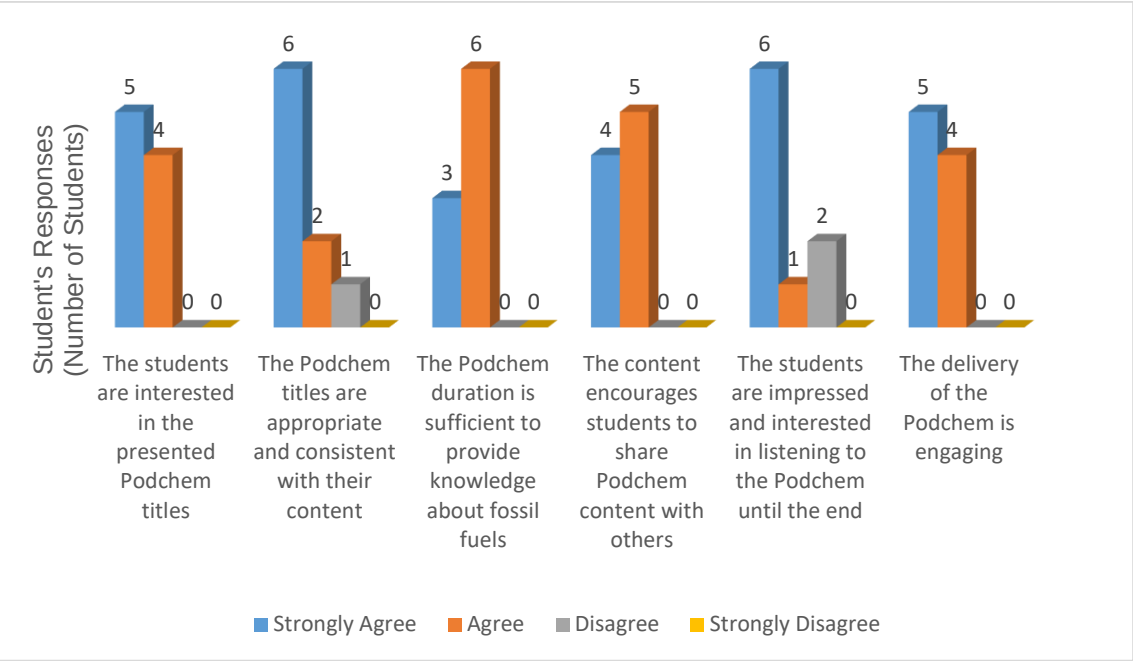

Figure 3. Podcast Media Assessment from the Podacst Appearance Aspect (Source: author's document)

This balance was achieved by adding soft background music that complemented the podcast content without being distracting and incorporating appropriate sound effects to maintain students' interest throughout the episode. These findings align with Susilowati's research, which suggests that educators should create short, lively, and entertaining podcasts, avoiding long, lecture-style formats [26]. The podcasts in this study were designed to be brief, with each episode lasting around three minutes.

Podcasts should be considered a supplement to classroom learning rather than a replacement. For example, pre-class podcasts can motivate students and make learning more effective by providing background knowledge and preparing them for more engaged and collaborative learning. Educators should avoid simply duplicating content available in lecture notes or textbooks; instead, they should use podcasts to summarise key points and offer additional insights. This study used " PodChem " as a supplementary medium, presenting essential concepts not fully covered in the students' textbooks. Moreover, educators must prepare and explore ways to use technology that empowers students to generate their ideas and content.

Additionally, the study found that 8 out of 9 students expressed a need for podcasts as a complementary medium in learning chemistry.

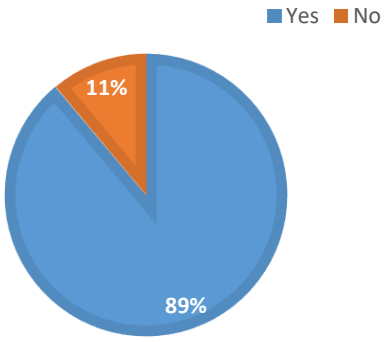

Figure 4. Student Responses to Podcast Media (Source: author's document)

Figure 4 illustrates the distribution of students' responses to the podcast. This data was gathered through a questionnaire offering yes or no options to gauge students' interest in having podcasts as supplementary media for future chemistry lessons. 88.9% of respondents desired podcasts to be used as complementary media in their ongoing learning. Eight students chose "yes," citing reasons such as the ability to gain additional insights, the podcasts being more engaging and flexible, easier to understand, and different from other learning methods.

The findings of this study align with previous research and best practices implemented by several universities, which have highlighted the effectiveness of podcasts as supplementary learning tools in addition to face-to-face classroom instruction and textbook reading. Podcasts can help students better grasp concepts, theories, and applications that might have yet to be fully covered during class [26]. According to the criteria outlined in prior studies [26], effective podcasts should feature a variety of relevant topics, be presented casually uniquely, and be short enough to be easily explored, understood, and listened to anywhere [21].

Based on this assessment, "PodChem" is well-suited for use as complementary media in chemistry education, particularly for topics like hydrocarbons and petroleum. However, given the limitations of this study, further research is recommended to develop podcasts as supplementary media in chemistry learning and to test their effectiveness on a larger scale to obtain more comprehensive and relevant data.

CONCLUSION

The "PodChem" chemistry podcast has been successfully produced using the Anchor application. This podcast has been validated regarding content, functionality, and appearance as a complementary medium for teaching hydrocarbons and petroleum. Implementing "PodChem" in chemistry education received positive feedback from students. Most students welcomed podcasts in their learning, citing that they found podcasts more interesting, insightful, and easier to understand. In conclusion, using "PodChem" to learn about hydrocarbons and petroleum has increased student interest in chemistry, with 88.9% of respondents expressing a desire for continued use of podcast media in future chemistry lessons. As an audio medium, podcasts are well-suited for introducing subject matter, applying chemistry concepts to everyday life, and delivering content with a macroscopic focus. "PodChem" received positive ratings from students across content, functionality, and appearance, with an average rating of 3.5 on a Likert scale of 1-4, indicating general agreement that the podcast met high standards in these areas. The use of podcasts as complementary media has the potential to enhance student engagement and understanding, aligning with existing literature. Integrating podcasts into inclusive education could significantly improve the quality of education for students with special needs and, in the long term, contribute to reducing educational disparities. Further research is needed to explore the long-term effects of podcasts in chemistry education, including long-term retention and integration

with other teaching methods. Educators should consider incorporating podcasts into their teaching strategies to provide a varied and engaging learning experience, such as integrating podcast media into contextual teaching and learning.

REFERENCES

[1] P. Indonesia, "Keputusan Menteri Pendidikan, Kebudayaan, Riset, dan Teknologi Republik Indonesia Nomor 56/M/2022 Tentang Pedoman Penerapan Kurikulum dalam Rangka Pemulihan Pembelajaran," 2022.

[2] C. Moser, "Manufacturing and Characterization of Cellulose Nanofibers," KTH Royal Institute of Technology, 2019.

[3] D. Riyan Rizaldi and Z. Fatimah, "Merdeka Curriculum: Characteristics and Potential in Education Recovery after the COVID-19 Pandemic," *Int. J. Curric. Instr.*, vol. 15, no. 1, pp. 260–271, 2022.

[4] W. Ndari, Suyatno, Sukirman, and F. N. Mahmudah, "Implementation of the Merdeka Curriculum and Its Challenges," *Eur. J. Educ. Pedagog.*, vol. 4, no. 3, pp. 111–116, 2023. doi: 10.24018/ejedu.2023.4.3.648.

[5] P. Haug, "Understanding Inclusive Education: Ideals and Reality," *Scand. J. Disabil. Res.*, vol. 19, no. 3, pp. 206–217, 2017. doi: 10.1080/15017419.2016.1224778.

[6] D. W. Noviska and F. Anastasia, "Students' Learning Styles (VRAK Model) in Learning English," *Didakt. J. Kependidikan*, vol. 17, no. 1, pp. 58–70, 2023. doi: 10.30863/didaktika.v17i1.4132.

[7] R. Apriati, T. Cicik, S. Budiman, and N. Sitoresmi, "The Application of Differentiated Instruction (Learning Style) to Increase Students ' Learning Outcomes at SMKN 6 Semarang," *Pendidik. Profesi Guru*, pp. 1132–1142, 2023.

[8] S. Pang, "The Impact of a Podcast Project on Learning Outcomes: A Case Study of Two Content-based Courses," *Cambodia Educ. Rev.*, vol. 2, no. March, pp. 30–51, 2018. doi: 10.31020/cer.2018.2.1.30-51.

[9] R. Tytler, C. Malcolm, V. Kirkwood, D. Symington, and L. Darby, *Professional Development Provision for Teachers of Science and Mathematics in Rural and Regional Victoria*. Waurn Ponds, Australia: Deakin University, 2009.

[10] W. Ghartey, D. U. Bunbun, S. D. Fenuku, and K. B. Ghartey, "The Effects of Digital Media Instruction on Senior High School Students' Performance in Organic Chemistry Nomenclature," *Indones. J. Teach. Sci.*, vol. 1, no. March, pp. 97–108, 2024. doi: 10.17509/ijotis.v4i1.68763.

[11] C.-T. B. Ho, Y.-H. D. Chou, and H.-Y. V. Fang, "Technology Adoption of Podcast in Language Learning: Using Taiwan and China as Examples," *Int. J. e-Education, e-Business, e-Management e-Learning Technol.*, vol. 6, no. 1, pp. 1–13, 2016. doi: 10.17706/ijeeee.2016.6.1.1-12.

[12] P. R. Kinasih and Mery, "Students' Perception Towards Learning Literature Through Podcast," *Int. Conf. Lang. Linguist. Lit. Educ.*, no. August, 2022.

[13] S. C. Parija and P. Shanmuganathan, "Podcast — An Apt Learning Tool for Generation Z," vol. 17, p. 12909, 2020. doi: 10.5005/jp-journals-10085-8121.

[14] J. Götborg, E. Schönbeck, and A. L. Hankers, "The Influence of Relationships

on Podcasts' Opportunities to Maximize Revenue," *Int. Bus. Sch.*, no. May, 2019.

[15] M. Khaund, "ICT in Education : The Potential of Podcasting," 2007.

[16] S. S. Prakash, N. Muthuraman, and R. Anand, "Short-duration Podcasts as a Supplementary Learning Tool: Perceptions of Medical Students and Impact on Assessment Performance," *BMC Med. Educ.*, vol. 17, pp. 1–15, 2017. doi: 10.1186/s12909-017-0864-0.

[17] T. B. Bell, A. C. Cockburn, A. W. Wingkvist, and R. G. Green, "Podcasts as a Supplement in Tertiary Education: an Experiment with Two Computer Science Courses," pp. 1–8, 2007.

[18] H. Barjesteh and M. Ghaseminia, "Effects of Pre-Listening Task Types on the Development of EFL Learners' Listening Comprehension Ability," *Int. J. List.*, vol. 0, no. 00, pp. 1–15, 2019. doi: 10.1080/10904018.2019.1624087.

[19] W. R. Agarid and M. Nurzahra, "Analyzing Podcast Application To Improve Listening Ability," *Proj. (Professional J. English Educ.*, vol. 1, no. 3, p. 175, 2018.

[20] D. Dang, S. Moughnyeh, E. Stephens, V. Convers, S. Adkins-Jablonsky, and S. Raut, "A Pandemic Pivot: Podcast as an Active Engagement Tool in the Classroom and Beyond Teaching Tools and Strategies," *Teach. Tools Strategy.*, vol. 09, no. October, pp. 1–4, 2022.

[21] A. Carvalho, C. Aguiar, C. Carvalho, and R. Cabecinhas, "Influence of Podcast Characteristics on Higher Students' Acceptance," *Educ. Technol. a Better World*, vol. 302, no. November, pp. 417–426, 2009. doi: 10.1007/s11528-009-0318-8.

[22] S. McClung and K. Johnson, "Examining the Motives of Podcast Users," *J. Radio Audio Media*, vol. 17, no. 1, pp. 82–95, 2010. doi: 10.1207/s15507408jram1701_9.

[23] L. E. MacKenzie, "Science Podcasts: Analysis of Global Production and Output from 2004 to 2018," *R. Soc. Open Sci.*, vol. 6, no. 1, 2019. doi: 10.1098/rsos.181741.

[24] Sugiyono, *Metode Penelitian Kuantitatif, Kualitatif, dan R&D*. Bandung: Alfabeta, 2015.

[25] P. L. Leite, F. A. F. Torres, L. M. Pereira, A. de M. Bezerra, L. D. S. Machado, and M. R. F. da Silva, "Construction and Validation of Podcast for Teen Sexual and Reproductive Health Education," *Rev. Lat. Am. Enfermagem*, vol. 30, no. Special Issue, 2022. doi: 10.1590/1518-8345.5471.3572.

[26] R. D. Susilowati, Sutama, and N. Faiziyah, "Application of Podcasts on Spotify as a Mathematics Learning Media in the Middle of Covid-19 Pandemic," *J. Ris. Pendidik. Dan Inov. Pembelajaran Mat.*, vol. 4, no. 1, pp. 68–78, 2020. doi: 10.24036/jrpipm.v4i1.251.

[27] A. Chan, M. J. W. Lee, and C. McLoughlin, "Everyone's Learning with Podcasting: A Charles Sturt University Experience," *ASCILITE 2006 - Australas. Soc. Comput. Learn. Tert. Educ.*, vol. 1, no. January, pp. 111–120, 2006.

[28] Z. Cebeci and M. Tekdal, "Using Podcasts as Audio Learning Objects," *Interdiscip. J. e-Skills Lifelong Learn.*, vol. 2, no. January 2006, pp. 047–057, 2006. doi: 10.28945/117.

[29] H. Koppelman, "Using Podcasts in Distance Education," *Proc. Int. Conf. e-Learning 2013*, pp. 303–310, 2013.

[30] P. Edirisingha, G. Salmon, and J. Fothergill, "Profcasting: A Pilot Study and Guidelines for Integrating Podcasts in a

Blended Learning Environment," *Res. competence Dev. Online distance Educ. e-learning*, no. January, pp. 127–137, 2007.

[31] D. Tapp, "The Innovative Use of Podcasting to Support Under-Represented Groups," *Innov. Pract. High. Educ.*, vol. 1, no. April, pp. 1–8, 2013. doi: 10.11120/iphe.2013.00001.

[32] R. Darwis, "Students ' Perceptions Towards the Use of Podcast in Learning English: a Case Study of the Second Grade Students at One High School in Bandung," *J. English Educ.*, vol. 4, no. 2, pp. 80–100, 2016. doi: 10.24815/jee.v4i2.4157.