How do teachers design science learning media? A case study based on the Documentational Approach to Didactics

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Abstract: The development of learning media conducted by teachers is strongly influenced by their past experiences and the resources they have learned. This study highlights this by using the Documentational Approach to Didactics. This study focuses on two aspects: Reflective Mapping of a Teacher's Documentational Trajectory (RMDT) and Reflective Mapping of the Teacher's Resource System (RMRS). RMDT highlights important events experienced by teachers that influence the media or work they produce. Besides, this study investigates how teachers design science learning media, drawing on their past experiences and available resources. The case study involved two elementary school teachers: one created a comic about environmental issues, and the other produced a video on biodiversity. Interviews with both teachers were analyzed using thematic analysis. Furthermore, RMRS emphasizes the resources that teachers utilize. From the case study analyzing two teachers, it is illustrated that RMDT and RMRS influence the media developed by teachers because they connect with the events and resources employed by teachers. For example, the first teacher had received training in both comic development and socioscientific content. The second teacher, who developed a video about biodiversity, had prior experience in video production and self-taught video editing, including the use of various video editing software.

Keywords: Documentational Approach to Didactics; Reflective Mapping of a Teacher's Documentational Trajectory; Reflective Mapping of the Teacher's Resource System; Media

Introduction

The ability of teachers to develop learning media is evidence of their pedagogical competence (Biletsky et al., 2019; Rohs et al., 2019). Not only that, but the ability to develop media is also related to content knowledge and technological knowledge (Ilmi & Sunarno, 2020; Ismail & Nordin, 2021; Schubatzky et al., 2023). Several studies also link this ability to Technological, Pedagogical and Content Knowledge (TPACK), which emphasizes the interaction of competencies from these three aspects (Graham, 2011; Koehler & Mishra, 2009).

In forming this competence, teachers certainly have past experience. The experience referred to here encompasses the events that teachers have encountered during their careers, as well as the resources they have acquired throughout their careers (Gueudet & Trouche, 2008, 2009; Trouche, Rocha, et al., 2020). Analyzing this is crucial to understanding how teachers develop media. To get an in-depth analysis related to this, it is necessary to conduct a Documentational Approach to Didactics (DAD) (Gueudet & Trouche, 2008, 2009).

DAD was first introduced by Guedet and Trouche in 2007 (Gueudet & Trouche, 2008, 2009). This approach is inspired by the instrumental approach (Rabardel, 1995), and also instrumental orchestration (Trouche, 2004). In the evolution of DAD development, this approach initially emphasized more documentation work, resources, and documentation (Trouche, 2019; Trouche, Gueudet, et al., 2020). Subsequently, its development highlighted the collection of resources and origins of documentation (Trouche, 2019; Trouche,

Gueudet, et al., 2020). This approach has evolved further and has also investigated the reflective context of the investigation more thoroughly (Gueudet & Trouche, 2008, 2008, 2009; Trouche, 2019; Trouche, Gueudet, et al., 2020)

Trouche et al. (2019; 2020) stated that reflective investigation focuses on several points that are studied in depth. The first is a collection of various sources or materials used and produced by teachers. The second is mentoring or monitoring over a long period. The third is monitoring carried out both inside and outside the classroom. The fourth is reflective monitoring of the documentation work carried out by teachers. Fifth, teachers continuously compare or match their views on documentation work with the real results of the work. Geudet et al. (2011) clarified that this reflective investigation is feasible for tracking teachers' experiences and the resources they utilized. The results of this search can be used to analyze the relationship between media developed by teachers and the results of reflective investigations.

DAD has been widely employed in previous studies for various purposes (Ahl et al., 2022; Baştürk-Şahïn & Tapan-Broutin, 2018; Trouche, Rocha, et al., 2020; Trouche et al., 2023a). For example, research by Trouche et al. (2020) analyses how teachers carry out the transition to digital resources. Other research by Trouche et al. (2023b) highlights the conceptualization of teachers' interactions with resources in crossing languages and cultures.

Based on the information presented in the introduction, this paper employs DAD to investigate how teachers design science learning media. The purpose of this paper is to focus more on how the events experienced by teachers affect the way they develop media. Furthermore, it examines how educational resources influence the form and content of the media they produce.

Method

Context Study

This study employs a qualitative approach, adapting DAD (Gueudet & Trouche, 2008, 2009) to describe the background of how teachers develop science learning media. As explained previously, this study highlights the events experienced by teachers and the resources they use.

Participants and media

The participants in this study were two elementary school teachers from East Java, Indonesia. The media they developed were visual and audio-visual media. Teacher A developed an educational comic with an environmental issue theme, while teacher B developed an educational video about the diversity of living things. Teacher data is presented in Table 1. Participants in this study have voluntarily agreed to be interviewed about how the events they experienced and the educational resources they used influenced the development of science learning media.

Table 1. Teachers' biographical data

Teacher	Age	Gender	Years of teaching experience	Highest education level
Teacher A	45	Female	23 years	Bachelor of Education in Elementary School Teacher Education (Holds a Teacher Professional Certification)
Teacher B	32	Male	8 years	Bachelor of Education in Elementary School Teacher Education

Data collection

Table 2. Indicator and interview questions

Indicator	Interview Questions
RMDT	- Have you ever attended any seminars, workshops, or training sessions that provided you with the skills to develop science learning media in the past? - Can you give examples of work that you designed in the past?
RMRS	- When developing learning media, did you consult specific references, either printed or digital? - Which part inspired or became part of the content for the media that you developed?

Data collection was conducted through two methods: interviews (Adeoye-Olatunde & Olenik, 2021) and document analysis (Bowen, 2009). Interviews were conducted from March 3 to 12, 2025. The interview was a semi-structured interview, in which several core questions were then broken down into 3-4 prompt questions to obtain more in-depth data. The list of questions is presented in Table 2. The questions include indicators related to the Reflective Mapping of a teacher's Documentational Trajectory (RMDT) and the Reflective Mapping of the Teacher's Resource System (RMRS) (Gueudet & Trouche, 2008, 2009; Trouche, Gueudet, et al., 2020). RMDT aims to display important

events that have occurred in the past, as reported by teachers, that have affected their media development. Meanwhile, RMRS aims to identify the institutional and digital resources that teachers employ throughout their careers.

Data analysis

The data collected from the interviews were then analyzed thematically (Braun & Clarke, 2012). After being analyzed thematically, the data related to RMDT was organized into a timeline to identify the events that teachers have experienced during their careers, which are related to the learning media they have developed . Furthermore, the data related to RMRS was visually mapped to identify the resources used by teachers in developing science learning media (Gueudet & Trouche, 2008, 2009; Trouche, Gueudet, et al., 2020)..

Data reliability

The data in this study are qualitative, which tends to introduce bias; therefore, in the thematic data analysis (coding process), two coders are involved to minimize this bias. The involvement of two coders is included in ensuring data reliability (Cheung & Tai, 2021; O'Connor & Joffe, 2020). The first coder is the author, and the second coder is external, in this case, the principal of an elementary school. The results of data visualization are carried out if both coders agree on the mapped theme.

Result and Discussion

This section presents the results of the analysis based on RMDT and RMRS, which were conducted through interviews and the analysis of teacher documents. In detail, this section examines the results obtained in the following subsection.

Reflective Mapping of a Teacher's Documentational Trajectory

Based on the mapping results from RMDT, the visualisation results are presented in Figure 1. The orange box indicates events related to education. Furthermore, the green box is related to the Teacher's career level. The blue box is related to training, workshops, seminars, or conferences that teachers have attended in the past. Finally, the grey box indicates examples of media or written works that teachers have produced.

In the picture, it can be noticed that Teacher A has more experience related to the events she has attended, as well as her educational background. Additionally, she has significantly more teaching experience. Teacher A also has experience in writing scientific articles and is involved in scientific conferences. Teacher B is the

opposite, because he has less experience. There is a striking difference between when they started and the moment they began working. Teacher A began her work as a volunteer teacher, while Teacher B started immediately as a contract teacher.

Additionally, Teacher A's education differs slightly from Teacher B's, as Teacher A began her career with a diploma, while Teacher B started with a bachelor's degree. Both teachers have attended training on the curriculum and teaching materials. What distinguishes the two is the other events attended. Teacher A focuses more on events in content development or scientific conferences. For example, Teacher A has been involved in an international conference and has produced a scientific article in the proceeding. Furthermore, she has also attended training in comic development and the creation of socioscientific issues content. Teacher B focuses more on events in innovative learning and educational video creation.

Reviewed from the media or works that have been produced, interesting facts were found regarding the RMDT of the two teachers. Teacher A has just started developing educational comics after attending training on developing educational comics and content related to socioscientific issues. It relates to the media he developed about comics related to environmental issues. In contrast, Teacher B began developing educational videos before attending the training. The following is an interview transcript that clarifies this:

Teacher A: I got the idea to develop comics for learning after attending training on creating comics with comic website generators available on the Internet, such as Storyboard, Pixton, and Canva. Additionally, the training taught me how to create digital images using Procreate.

Teacher B: I learned video editing in college, so making videos has become my hobby. I also have a YouTube account that contains the learning process in class. Additionally, due to my interest in animals, I also create short videos about animal diversity. My skills have been further refined after attending training on creating educational videos.

From the results of the RMDT visualisation and the transcript representation, it is evident that teacher skills in media development can be acquired in two ways. The first way is through the training they receive while in the office. This training has a significant impact on enhancing their pedagogical and professional competence. A similar finding has also been reported in previous studies, highlighting the training process for teachers that affects their skills, which can be applied in learning (Abrori et al., 2024; Gibbs & Coffey, 2004; Randel et al., 2016). The second way is that teacher skills

are acquired before teachers become teachers, as seen in the case of Teacher B. Teacher B's ability in video editing was developed long before he became a teacher. Additionally, his interest in this topic helped him learn the editing process and publish it on social media platforms, such as YouTube. This method is better known as autodidactic. The process of acquiring skills autodidactically has also been studied by many individuals to enhance their hard and soft skills, which they prepare before entering the workforce (Azmi & Daulay, 2024; Kohler & Dietrich, 2021).
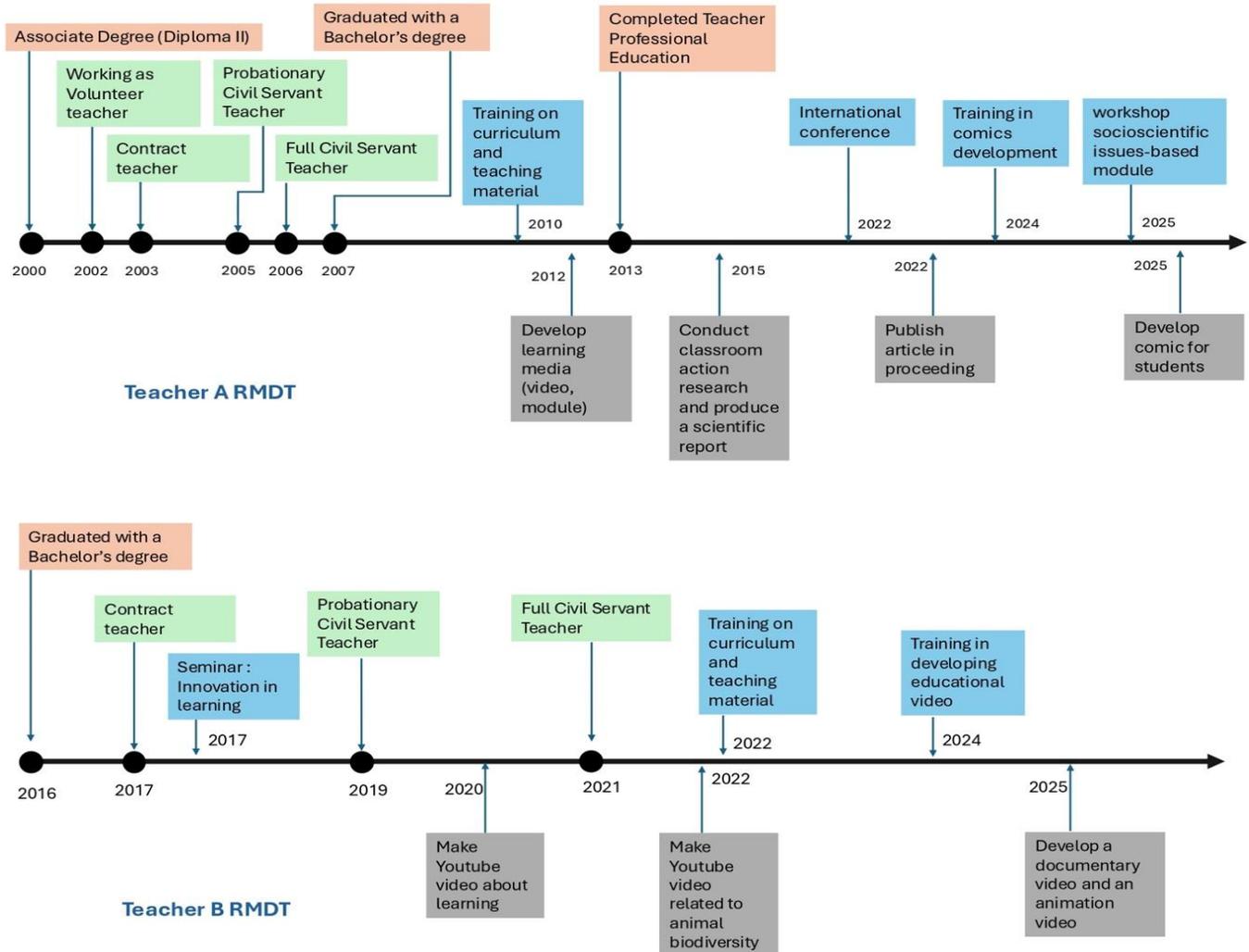

Figure 1. RMDT of teachers

*Reflective Mapping of the Teacher's Resource System*

RMRS describes institutional and digital resources used by teachers during their careers. Institutional resources typically include documents issued by the state through the Minister of Education, as well as other resources such as textbooks, references, and journal articles. Digital resources themselves are related to resources obtained on the Internet, such as videos, images, e-books, and other digital formats. Figure 2 shows the RMRS of the two teachers. The green circle shows the content and platform used by the teacher. Furthermore, the blue circle shows the type of resources used. Some resources are detailed again in the purple circle.

Because they developed different learning media (Teacher A created comics and Teacher B created videos), the resources they used were also distinct. However, they utilised the same resources, especially institutional resources, which include official textbooks from the Ministry of Education and curriculum books. Meanwhile, in the content section, Teacher A refered to textbooks, such as Biology by Campbell, to enrich the content of her comics. On the other hand, Teacher B focused more on science-related *YouTube* channels such as *Science Channel, Fun Science*, and *Kids Academy*. The

website platforms used reveal a stark contrast between Teacher A and Teacher B. Teacher A was more involved in using comic website generators, such as *Storyboard That, Pixton,* and *Canva.* In some parts, she also used Procreate (a drawing application for Apple devices) to create several visual elements that are integrated into his comics. The following is a transcript that represents the use of resources by Teacher A:

Teacher A: In developing comics, I mostly do it with websites that provide comic creation, such as Storyboard That and Pixton. I also use Canva occasionally because some of its templates are well-suited for creating comic strips. Sometimes, I use drawing applications such as Procreate to create comics, although sometimes using Procreate takes much time.
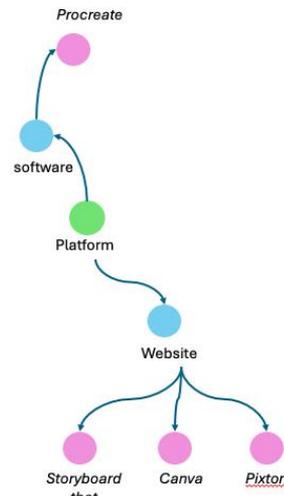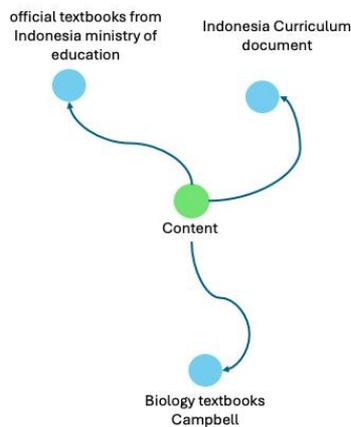
Teacher A RMRS
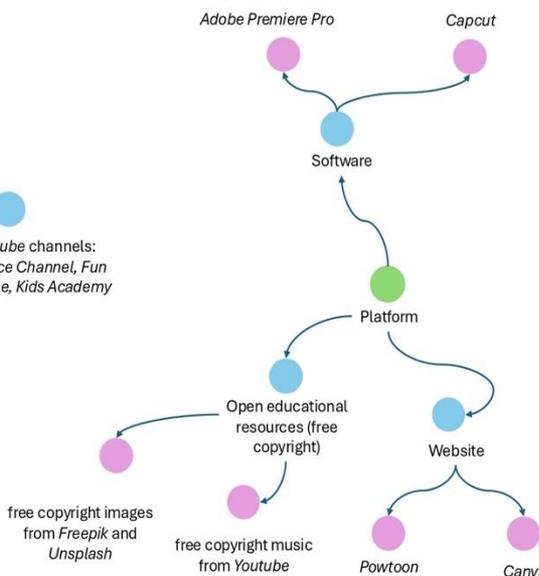
Teacher B RMRS

Figure 2. RMRS of teachers

Unlike Teacher A, Teacher B focused more on the platforms used in making videos, such as *Adobe Premiere Pro* and *CapCut* software. Additionally, he utilised websites that offer features for creating animated videos, such as *Powtoon* and *Canva.* In addition, he also stated that a part of the media uses open resources, including copyright-free images from *Freepik* and *Unsplash,* as well as copyright-free music obtained from *YouTube.* The following is a representation of an interview that illustrates this:

Teacher B: I create videos using various editing software, such as CapCut or Adobe Premiere Pro. For some animation features, I usually use Powtoon or Canva. I use only copyright-free image and music elements. For images, I take them from Freepik and Unsplash. While for music, I take them from YouTube.

From RMRS, it can be noticed that teachers used very different platforms depending on the type of media they developed. Both teachers, indeed, used some platforms such as Canva. Canva does have several features that support animation or templates for comics (Hapsari et al., 2024; Putri & Jusra, 2022; Widiarti, 2024). However, overall, all resources are very different. It indicates that the type of media developed influences the diversity of resources employed by teachers.

Viewed from the theme grouping, teachers use web-based platforms and softwares installed on computers. This indicates that teachers utilise platforms flexibly, both offline and online, demonstrating their ability to operate on various platforms. Web-based platforms demonstrate that current platforms can be accessed more easily, eliminating the need for complicated installation processes on existing devices (Liu et al., 2020).

An interesting finding is the use of open resources. It indicates that teachers also carefully explore resources in their use to avoid copyright violations. Copyright is sometimes a sensitive issue when someone develops a video, as it can impact, for example, the video being blocked (Erickson & Kretschmer, 2018; Liang, 2020) or the audio being removed from a video by a particular platform (Ezell, 2024). Teacher awareness in recognising this is an important point that can serve as a reference for other teachers when reviewing the elements used in developing learning media.

This study holistically illustrates that teachers' past training (whether formal or self-taught) significantly impacts their skills in developing learning media. Developing training that extends beyond science content, such as the use of technology, is essential to expand science teachers' skills, particularly in technological knowledge. Research by Chaipidech et al. (2022) conducted training that emphasized improving teachers' TPACK. This training demonstrated that teachers were able to effectively package learning content, both in terms of content and didactics, using a variety of technology platforms. However, when viewed in terms of challenges, particularly in Indonesia, implementing this type of training — especially in integrating content and learning design —is a significant issue. (Sulaeman et al., 2022). Suggest that the context in this study, through a documentary approach to didactics, can be implemented as an alternative to track teachers' past experiences and thus serve as a reference in providing training tailored to their needs.

Another area of concern is the challenges associated with the use of digital technology, given that the study's findings indicate that most of the resources teachers use are related to digital tools. However, in Indonesia, many teachers still struggle with technology, as shown in a study by Abrori et al. (2024) , which revealed that unfamiliarity with digital learning platforms is a significant issue in training. This study's approach also offers the potential to evaluate the digital resources teachers use, allowing skill gaps in using these resources to be addressed through training tailored to teachers' specific technological knowledge.

Conclusion

This study describes how media is developed by examining the Reflective Mapping of a teacher's Documentational Trajectory (RMDT) and the Reflective Mapping of the teacher's Resource System (RMRS). The two teachers who participated in this study analyzed their RMDT and RMRS to determine if these two factors influenced the media they developed. From the results obtained, RMDT highlights the important events that teachers experience, which influence the media or work they produce. In comparison, RMRS emphasizes the resources that teachers use. These two things are directly related to the media produced.

This study still has limitations, as some aspects have not been adequately highlighted. Suppose referring to the study by Trouche et al. (2020), which is more detailed and highlights many aspects of this type of research. Their study also highlights the Inferred Mapping of a teacher Documentation Trajectory (IMDT). In addition, their study also highlights documentation work, stages, issues and moments when teachers develop media. While this study only focuses on RMDT and RMRS. However, this study can serve as a foundation for the author to develop it further in the future.

Conflicts of Interest
The author declare no conflict of interest

References

Abrori, F. M., Saimon, M., Lavicza, Z., & Anđić, B. (2024). Challenges and opportunities of training teachers to develop comics for teaching socio-scientific issues. *Media Practice and Education*, 25(1), 56–76. https://doi.org/10.1080/25741136.2023.2245303

Adeoye-Olatunde, O. A., & Olenik, N. L. (2021). Research and scholarly methods: Semi-structured interviews. *Journal of the American College of Clinical Pharmacy*, 4(10), 1358–1367.

Ahl, L. M., Helenius, O., & Koljonen, T. (2022). Gauging fidelity to an implemented teaching model through the lens of the documentational approach to didactics. *Implementation and Replication Studies in Mathematics Education*, 2(1), 45–75.

Azmi, N., & Daulay, S. H. (2024). Technology Role in Improving Autodidactic Learning Outcomes at English Language Education. *International Journal of Language Teaching and Education*, 8(1).

Baştürk-Şahïn, B., & Tapan-Broutin, M. (2018). *Analysing teacher candidates' evolution into teachers through documentational approach*. 43–47.

Biletsky, V., Onkovych, H., & Yanyshyn, O. (2019). Media education technologies in developing students' professional competence. *Scientific Journal WEST-EAST*, 2(1), 110–114.

Bowen, G. A. (2009). Document analysis as a qualitative research method. *Qualitative Research Journal*, 9(2), 27–40.

Braun, V., & Clarke, V. (2012). Thematic analysis. In *APA handbook of research methods in psychology, Vol 2: Research designs: Quantitative, qualitative, neuropsychological, and biological* (pp. 57–71). American Psychological Association. https://doi.org/10.1037/13620-004

Chaipidech, P., Srisawasdi, N., Kajornmanee, T., & Chaipah, K. (2022). A personalized learning system-supported professional training model for teachers' TPACK development. *Computers and Education: Artificial Intelligence*, 3, 100064.

Cheung, K. K. C., & Tai, K. W. H. (2021). The use of intercoder reliability in qualitative interview data analysis in science education. *Research in Science & Technological Education*, 0(0), 1–21. https://doi.org/10.1080/02635143.2021.1993179

Erickson, K., & Kretschmer, M. (2018). This video is unavailable. *J. Intell. Prop. Info. Tech. & Elec. Com. L.*, 9, 75.

Ezell, K. J. (2024). Copyright x TikTok: Sync Rights in the Digital Age. *NYUL Rev.*, 99, 1045.

Gibbs, G., & Coffey, M. (2004). The impact of training of university teachers on their teaching skills, their approach to teaching and the approach to learning of their students. *Active Learning in Higher Education*, 5(1), 87–100.

Graham, C. R. (2011). Theoretical considerations for understanding technological pedagogical content knowledge (TPACK). *Computers & Education*, 57(3), 1953–1960.

Gueudet, G., Pepin, B., & Trouche, L. (2011). *From text to'Lived'resources: Mathematics curriculum materials and teacher development* (Vol. 7). Springer science & business media.

Gueudet, G., & Trouche, L. (2008). Du travail documentaire des enseignants: Genèses, collectifs, communautés. Le cas des mathématiques. *Education et Didactique*, 2–3, 7–33.

Gueudet, G., & Trouche, L. (2009). Towards new documentation systems for mathematics teachers?

Educational Studies in Mathematics, 71(3), 199–218. https://doi.org/10.1007/s10649-008-9159-8

Hapsari, A. N., Risdianto, E., & Medriati, R. (2024). Development of Canva Based Digital Comics on Straight Motion Kinematics Materials For Student's Learning Motivation Orientation. *Kasuari: Physics Education Journal (KPEJ)*, 7(1), 66–77.

Ilmi, A. M., & Sunarno, W. (2020). Development of TPACK based-physics learning media to improve HOTS and scientific attitude. *Journal of Physics: Conference Series*, 1440(1), 012049. https://iopscience.iop.org/article/10.1088/1742-6596/1440/1/012049/meta

Ismail, M., & Nordin, S. (2021). Development of multimedia application using TPACK framework. *2021 Fifth International Conference on Information Retrieval and Knowledge Management (CAMP)*, 46–51. https://ieeexplore.ieee.org/abstract/document/9498085/

Koehler, M., & Mishra, P. (2009). What is technological pedagogical content knowledge (TPACK)? *Contemporary Issues in Technology and Teacher Education*, 9(1), 60–70.

Kohler, S., & Dietrich, T. C. (2021). Potentials and limitations of educational videos on YouTube for science communication. *Frontiers in Communication*, 6, 581302.

Liang, M. (2020). Copyright issues related to reproduction rights arising from streaming. *The Journal of World Intellectual Property*, 23(5–6), 798–814.

Liu, Z.-Y., Lomovtseva, N., & Korobeynikova, E. (2020). Online learning platforms: Reconstructing modern higher education. *International Journal of Emerging Technologies in Learning (iJET)*, 15(13), 4–21.

O'Connor, C., & Joffe, H. (2020). Intercoder Reliability in Qualitative Research: Debates and Practical Guidelines. *International Journal of Qualitative Methods*, 19, 1609406919899220. https://doi.org/10.1177/1609406919899220

Putri, M. A., & Jusra, H. (2022). Pengembangan Media Audio Visual Dengan Animasi Berbasis Canva Pada Peserta Didik Kelas Vi Sd. *Jurnal Pendidikan Dasar*, 13(01), 164–174.

Rabardel, P. (1995). *Les hommes et les technologies; approche cognitive des instruments contemporains*. Armand colin.

Randel, B., Apthorp, H., Beesley, A. D., Clark, T. F., & Wang, X. (2016). Impacts of professional development in classroom assessment on teacher and student outcomes. *The Journal of Educational Research*, 109(5), 491–502.

Rohs, M., Schmidt-Hertha, B., Rott, K. J., & Bolten, R. (2019). Measurement of media pedagogical competences of adult educators. *European Journal for*

Research on the Education and Learning of Adults, *10*(3), 307–324.

Schubatzky, T., Burde, J.-P., Große-Heilmann, R., Haagen-Schützenhöfer, C., Riese, J., & Weiler, D. (2023). Predicting the development of digital media PCK/TPACK: The role of PCK, motivation to use digital media, interest in and previous experience with digital media. *Computers & Education*, *206*, 104900.

Sulaeman, N. F., Putra, P. D., & Kumano, Y. (2022). Towards integrating STEM education into science teacher preparation programmes in indonesia: A challenging journey. In *Concepts and Practices of STEM Education in Asia* (pp. 237-252). Singapore: Springer Nature Singapore

Trouche, L. (2004). Managing the complexity of human/machine interactions in computerized learning environments: Guiding students' command process through instrumental orchestrations. *International Journal of Computers for Mathematical Learning*, *9*, 281–307.

Trouche, L. (2019). Evidencing missing resources of the documentational approach to didactics. Toward ten programs of research/development for enriching this approach. *The'resource'approach to Mathematics Education*, 447–489.

Trouche, L., Adler, J., & Remillard, J. T. (2023a). Conceptualizing teachers' interactions with resources in crossing languages and cultures. *ZDM–Mathematics Education*, *55*(3), 497–519.

Trouche, L., Adler, J., & Remillard, J. T. (2023b). Conceptualizing teachers' interactions with resources in crossing languages and cultures. *ZDM–Mathematics Education*, *55*(3), 497–519.

Trouche, L., Gueudet, G., Pepin, B., & Aldon, G. (2020). L'approche documentaire du didactique. *DAD-Multilingual*.

Trouche, L., Rocha, K., Gueudet, G., & Pepin, B. (2020). Transition to digital resources as a critical process in teachers' trajectories: The case of Anna's documentation work. *ZDM*, 1–15.

Widiarti, Y. (2024). Canva and Comic Strips: Facilitate on Teaching Writing Instruction. *International Journal of Contemporary Studies in Education (IJ-CSE)*, *3*(3), 245–255.