

THE EFFECTIVENESS OF MOTION GRAPHIC MEDIA IN ENHANCING ADOLESCENTS' KNOWLEDGE AND ATTITUDES REGARDING DIABETES MELLITUS

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ABSTRACT

Background: Diabetes mellitus is a chronic condition that arises when the body is unable to regulate blood glucose levels effectively. The causes of diabetes mellitus are multifactorial, encompassing factors such as age, weight, family history, and lifestyle choices. A lack of knowledge and awareness among adolescents regarding diabetes mellitus may contribute to the rising incidence of the disease. Motion graphic media, as an audiovisual medium, presents information in a format that can be both seen and heard, making it a potentially effective tool for education. This study aims to assess the effectiveness of motion graphic media in enhancing the knowledge and attitudes of students at SMA Negeri 6 Surakarta towards diabetes mellitus.

Methods: This research employs a quantitative design with a control group pre-test post-test approach. The study uses cluster random sampling, and data analysis is conducted using Paired T-tests and One-Way ANOVA.

Results: The intervention group demonstrated a significant increase in knowledge, with a mean improvement of 5.13 (Paired T-test p-value = 0.000, <0.05), while the control group showed a smaller increase of 0.43 (Paired T-test p-value = 0.018, <0.05). For attitude, the One-Way ANOVA test indicated no significant difference in pre-test results between the intervention and control groups (p-value = 0.634, >0.05). However, post-test results revealed a significant difference between the two groups (p-value = 0.000, <0.05).

Conclusion: Motion graphic media is an effective tool for enhancing the knowledge and attitudes of students at SMA Negeri 6 Surakarta regarding diabetes mellitus.

Keywords: Diabetes mellitus, Motion Graphic, Knowledge, Attitude

INTRODUCTION

Diabetes mellitus among adolescents has emerged as a significant health concern, driven by various contributing factors, including unhealthy dietary practices, insufficient physical activity, and rising obesity rates. Research indicates that modern lifestyles, particularly the consumption of fast food, play a critical role in the increasing prevalence of diabetes cases within this population. A study has demonstrated that adolescents who regularly consume fast food are at a heightened risk of developing metabolic disorders, including diabetes mellitus. Furthermore, the prevalence of obesity among adolescents is closely linked to elevated blood glucose levels, which are primary indicators of diabetes (Sartika, 2023). These findings underscore the

urgent need for public health interventions aimed at promoting healthier eating habits and encouraging physical activity to mitigate the rising incidence of diabetes among adolescents (Prihaningtyas, 2020).

The Indonesian Pediatrician Association has reported a concerning 70-fold increase in the prevalence of diabetes among children from 2010 to January 2023, with a total of 1,645 affected children in Indonesia, translating to a prevalence rate of 2 cases per 100,000 children. Notably, approximately 60% of those diagnosed are girls, and age distribution reveals that 46% of cases occur in children aged 10-14 years, while 31% are in those aged 14 years and older. The rising incidence of diabetes in children and adolescents is indicative of a serious public health issue, largely attributed to unhealthy modern lifestyles (Ulya, 2023).

Given the potential negative consequences associated with diabetes, it is imperative to enhance prevention efforts through educational initiatives focused on healthy dietary practices and the importance of regular physical activity (Silalahi, 2019). Furthermore, for adolescents already diagnosed with diabetes, consistent monitoring and appropriate treatment are essential to mitigate complications and improve their overall quality of life (Wicklow, 2021).

The efficacy of motion graphics in health education has garnered increasing recognition as a potent tool for enhancing learning outcomes and improving knowledge retention across diverse populations. Characterized by animated visuals and engaging narratives, motion graphics have demonstrated significant improvements in educational experiences compared to traditional methodologies.

Empirical evidence supports this assertion; for instance, conducted a study that underscored the effectiveness of educational videos, including those incorporating motion graphics, in augmenting short-term knowledge acquisition among patients, particularly in the context of self-care practices during the COVID-19 pandemic (Khorammakan et al, 2023). This finding corroborates the research of Wiana et al. (2018), which revealed that students exposed to interactive multimedia based on motion graphics exhibited superior learning outcomes compared to their counterparts who received conventional instruction. These studies collectively underscore the potential of motion graphics as a valuable pedagogical tool in health education, capable of facilitating more effective knowledge dissemination and retention.

In a preliminary study conducted at SMA Negeri 6 Surakarta through interviews with several students, it was found that many students had limited exposure to information about diabetes and engaged in behaviors that posed significant risk factors for the disease. These high-risk behaviors included consuming

more than four tablespoons of sugar per day, drinking less than two liters of water daily, engaging in less than 150 minutes of physical activity per week, and, in some cases, having family members with diabetes. These findings suggest that students at SMA Negeri 6 Surakarta are at a relatively high risk of developing diabetes mellitus. Given this background, the researcher is interested in investigating the effectiveness of audiovisual motion graphic media in enhancing students' knowledge and attitudes towards diabetes mellitus. High school students were selected as respondents for this study due to the rising prevalence of diabetes among adolescents, positioning them as an important target group for educational interventions aimed at preventing further increases in diabetes incidence in this population.

METHODS

This research utilizes a quantitative approach with a quasi-experimental method, specifically employing a control group pre-test post-test design. The study population comprises 790 students from the 10th and 11th grades of SMA Negeri 6 Surakarta. Cluster random sampling was employed to select a minimum of 89 respondents, as determined by the Slovin formula with a 10% error margin.

The school offers a comprehensive three-year curriculum encompassing Natural Sciences (MIPA), Social Sciences (IPS), and Language (IBB) classes. From a total population of 1,167 students (n=448 male, 38.4%; n=719 female, 61.6%), a sample of 90 participants from grades X and XI was selected using cluster random sampling. The sample was equally divided into control and intervention groups (n=45 each) from both 10th and 11th grades. The study investigates motion graphic media as the independent variable and students' knowledge and attitudes towards diabetes mellitus as dependent variables. Data collection

involved pre-test and post-test questionnaires for primary data, supplemented by secondary data from relevant institutions.

The intervention consisted of a one-minute motion graphic video on diabetes mellitus prevention, produced by the Ministry of Health. Knowledge assessment utilized 15 true-false questions, with results categorized into four levels: good (76-100%), adequate (56-75%), poor (40-55%), and very poor (<40%). Attitude evaluation employed 19 statements, with outcomes classified as positive or negative based on median values. All research instruments underwent rigorous validity and reliability testing prior to implementation.

The data analysis process encompassed four crucial stages: editing to verify questionnaire completeness, coding to convert textual data to numerical format, processing to prepare data for analysis, and cleaning to ensure data accuracy. Statistical analysis employed a paired T-test for knowledge assessment and a One-Way ANOVA test for attitude analysis, given the non-parametric nature of the latter. The significance level was set at $\alpha=0.05$, with the research hypothesis accepted if the α value fell below this threshold, indicating a significant difference between treatment and control groups.

Data processing was conducted using SPSS software, followed by comprehensive descriptive and analytical discussions to provide a thorough interpretation of the research findings. This methodological approach ensures a robust examination of the impact of motion graphic media on students' knowledge and attitudes regarding diabetes mellitus, contributing valuable insights to the field of health education and intervention strategies.

RESULTS AND DISCUSSION

Study Setting and Participant Characteristics

Demographic analysis revealed the following distribution: age, gender and grade level (table 1).

Table 1. Age Distribution of Participants

Group	Age				n
	15	16	17	18	
Control	7	28	10	0	45
Intervention	4	33	7	1	45
Total	11	61	17	1	90
(Percentage)	(12.2)	(67.8)	(18.9)	(0.01)	(100)

The majority of participants in both groups are 16 years old (67.8%), which is consistent across the Control and Intervention groups. The chi-square analysis resulted in a *p-value* of 0.43, which is higher than the common significance level of 0.05. This means that there is no statistically significant difference in age distribution between the Control and Intervention groups. Each age group's distribution across the two groups aligns closely with the expected values, indicating that the age distribution is well-balanced between the groups.

Table 2. Gender Distribution of Participants

Group	Gender		n
	Male	Female	
Control	14	31	45
Intervention	20	25	45
Total	34	56	90
(Percentage)	(37.78)	(62.22)	(100)

The overall gender distribution shows that there are more females than males in both groups, but this difference is more pronounced in the Control group (69% female vs. 31% male) compared to the Intervention group (56% female vs. 44% male) (Table 2). While there is a slight imbalance in gender distribution, the overall group makeup is still fairly even, and this difference is unlikely to have a significant impact on the study outcomes.

Table 3. Grade Distribution of Participants

Group	Grade		n
	X	XI	
Control	30	15	45
Intervention	32	13	45
Total	34	56	90
(Percentage)	(37.78)	(62.22)	(100)

The distribution across grades is nearly identical between the Control and Intervention groups (Table 3). Both groups are dominated by Grade X participants (approximately two-thirds of each group). This distribution suggests that there is no significant imbalance between the two groups in terms of grade levels. Therefore, the participants are likely to have similar academic backgrounds and levels of experience.

The demographic analysis reveals that the Control and Intervention groups are well-matched, with no significant differences across age, gender, or grade distribution. This balanced distribution ensures that any results from the study can be confidently attributed to the interventions or factors being tested, rather than demographic imbalances. The study is set up for fair comparison, allowing for robust conclusions to be drawn from the data.

Knowledge Assessment

In this study, a paired T-test was employed to analyze the knowledge test data. The data, although ordinal in nature and measured using a true/false scale, were treated as parametric, as they met the assumptions required for parametric testing. The paired T-test was selected because it is appropriate for comparing two related groups, such as pre- and post-intervention knowledge scores. This approach was used to determine whether there was a statistically significant difference in participants' knowledge following the intervention. The use of this test is justified given the design of the study and the characteristics of the data, allowing for a rigorous evaluation of the intervention's impact on knowledge acquisition.

Table 4. Results for Knowledge Assessment

Group	Knowledge Test Result				n
	Good	Adequate	Poor	Very Poor	
Pre Test					
Control	6	11	18	10	45
Intervention	8	9	16	12	45
Sub total	14	20	34	22	90
Post Test					
Control	9	9	19	8	45
Intervention	38	6	1	0	45
Sub total	47	15	20	8	90

The findings from the knowledge assessment clearly highlight the significant impact of the intervention on improving participants' knowledge. Prior to the intervention, both the control and intervention groups exhibited relatively low knowledge levels, as reflected in their pre-test scores. Following the intervention, the results show a stark contrast between the two groups (Table 4.). The intervention group experienced a substantial improvement, with 84.4% of participants achieving a "Good" score in the post-test. This represents a dramatic increase from the pre-test, where only 17.8% of participants in the intervention group had scored "Good." In comparison, the control group showed only marginal improvement. While the percentage of participants scoring "Good" increased slightly from 13.3% in the pre-test to 20% in the post-test, the majority of participants remained within the "Poor" and "Very Poor" categories.

Table 5. Paired T-Test Results for Knowledge Assessment

Group	Mean	n	Std. Dev	Std. Err. Mean	Sig. (2-Tailed)
<i>Control</i>					
Pre Test	8.84	45	2.504	.373	0.018
Post Test	9.27	45	2.879	.429	
<i>Intervention</i>					
Pre Test	8.78	45	3.103	.463	0.000
Post Test	13.91	45	1.459	.217	

The table 5 above demonstrates a notable increase in the mean knowledge score within the intervention group, with a rise of 5.13 points from a pre-test score of 8.78 to a post-test score of 13.91. The paired T-test analysis yielded a p-value of 0.000 ($p < 0.05$), indicating statistical significance and supporting the acceptance of

the alternative hypothesis (H1). Consequently, it can be concluded that there is a significant difference in knowledge before and after the intervention using motion graphic media in the intervention group. In contrast, the control group exhibited a smaller increase in mean knowledge score, with an improvement of 0.43 points, from 8.84 in the pre-test to 9.27 in the post-test. The paired T-test for the control group yielded a p-value of 0.018 ($p < 0.05$), suggesting a difference in knowledge before and after testing. However, the magnitude of this change is minimal, with only a 0.43-point increase in mean score, indicating that the knowledge improvement in the control group is not substantial.

Table 6. Independent Sample T-test Results for Intervention and Control Groups

	F	Sig.	t	df	Sig. (2-Tailed)
Equal variance assumed	15.857	.000	9.652	88	.000
Equal variance not assumed			9.652	65.193	.000

Table 6 demonstrate that the use of motion graphic media as an educational tool significantly enhances students' knowledge about diabetes mellitus. The intervention group showed a substantial increase in mean knowledge scores, with a statistically significant improvement of 5.13 points after the intervention, as confirmed by the paired T-test ($p < 0.000$). This contrasts with the control group, where only a modest gain of 0.43 points was observed, despite the statistical significance of the result ($p = 0.018$). Furthermore, the independent samples T-test revealed a significant difference between the post-test scores of the intervention and control groups ($p < 0.000$), underscoring the superior effectiveness of motion graphic media in promoting knowledge acquisition.

The effectiveness of motion graphics in health education has garnered increasing attention in recent years, particularly in its ability to enhance knowledge retention and engagement among adolescents. Motion

graphics, characterized by animated visuals and dynamic presentations, have been shown to significantly improve learning outcomes compared to traditional educational methods. For instance, a study by Hapsari et al. demonstrated that elementary school students who learned through motion graphic animation videos exhibited better learning outcomes than those who received conventional instruction Hapsari et al. (2019). This aligns with findings from Wiana et al., which indicated that interactive multimedia based on motion graphics led to higher achievement in mastering concepts and skills among students compared to traditional learning methods (Wiana et al., 2018).

Moreover, the use of motion graphics has been linked to increased knowledge retention in various health education contexts. Puspita and Syahida found that participants who engaged with motion graphic content scored significantly higher in knowledge assessments compared to those who utilized leaflet-based materials (Puspita & Syahida, 2020). This suggests that motion graphics can effectively convey complex health information in a more digestible and engaging format, thereby enhancing understanding and retention. Similarly, the systematic review by González-Argote et al. highlighted the positive impact of real-time graphics, including motion graphics, on skill development and knowledge acquisition in health education settings (González-Argote et al., 2023).

The tailored design of motion graphics can lead to improved understanding of complex information. Lonsdale and Liao's research revealed that user-centered motion graphics significantly impacted the understanding of health-related information, suggesting that the aesthetic and functional aspects of motion graphics play a crucial role in knowledge retention (Lonsdale & Liao, 2018). Similarly, Oktanizar and Kurniawan highlighted the successful development of motion graphics for educational purposes, emphasizing the

importance of balancing information density with viewer engagement to optimize learning experiences (Oktanizar & Kurniawan, 2021). This is further supported by Nurhayati, who found that audio-visual media, including animations, significantly enhanced knowledge and skills in health education, demonstrating the broader applicability of motion graphics in various educational settings (Nurhayati, 2023)

These findings strongly suggest that motion graphic media offers a highly effective method for enhancing educational outcomes, particularly in conveying complex health-related information, and should be considered for wider implementation in educational strategies.

Attitude Assessment

The attitude assessment in this study utilized ordinal data measured on a Likert scale, which is classified as non-parametric data according to Jamieson (2004). Given this classification, the One-Way ANOVA was selected as the appropriate statistical test to analyze the data. This method was chosen because it allows for the comparison of mean differences across multiple groups, even when dealing with ordinal scales, providing insights into whether there are significant differences in participants' attitudes across the groups studied. The use of One-Way ANOVA ensures a robust approach to analyzing non-parametric data in this context, aligning with the study's design and objectives.

Table 7. Results for Attitude Assessment

Group	Attitude Test Result		n
	Positive	Negative	
Pre Test			
Control	25	20	45
Intervention	24	21	45
Sub total	49	41	90
Post Test			
Control	29	16	45
Intervention	45	0	45
Sub total	74	16	90

Attitudes were categorized as positive (score 39-76) or negative (score 19-38) (Table 8). The post-test results indicate that the

intervention had a significant impact on improving participants' attitudes. The intervention group experienced a complete transformation, with all participants shifting from a mix of positive and negative attitudes to entirely positive attitudes post-intervention. This stark contrast to the control group, where a notable portion of participants still held negative attitudes, suggests that the intervention was highly effective in fostering positive attitude change. The modest improvement in the control group, from 55.6% to 64.4% positive attitudes, indicates that without the intervention, the shift in attitudes was relatively small.

Table 8. One_Way ANOVA Results for Attitude Assessment

Group	Sum of Squares	df	Mean Square	F	Sig
Pre Test					
Between Groups	16.044	1	16.044	.228	.634
Within Groups	6192.58	88	70.370		
Sub Total	6208.622	89			
Post Test					
Between Groups	6417.78	1	6417.778	112.943	.000
Within Groups	5000.44	88	56.823		
Sub Total	11418.22	89			

The results of the One-Way ANOVA test conducted to assess attitudes in this study reveal significant findings regarding the impact of the intervention. The data in Table 8 compares the pre-test and post-test attitudes between the intervention and control groups, providing evidence of how the intervention influenced participants' attitudes. The pre-test results indicate no significant difference between the intervention and control groups prior to the intervention.

The One-Way ANOVA yielded a p-value of 0.634 ($p > 0.05$), suggesting that both groups started with relatively similar attitudes toward the subject matter, and no statistical difference existed between them at the beginning of the study. Following the intervention, the One-Way ANOVA test results revealed a highly significant difference between the two groups, with a p-value of 0.000

($p < 0.05$). This indicates that the intervention group, which received education through motion graphic media, experienced a substantial positive shift in attitudes compared to the control group, which did not receive the same media intervention.

The impact of motion graphics on health attitudes has received considerable attention in recent research, particularly regarding their efficacy in conveying health-related messages. Motion graphics, which integrate visual elements with dynamic movement, enhance the communication of health information by making it more engaging and easier to understand. This is especially important in addressing the fragmented attention spans of audiences, particularly adolescents, who are frequently exposed to information in digital environments. For example, Lazard (2021) highlights that visual elements can facilitate the positive reception and comprehension of critical health information, illustrating key concepts that promote message processing, which is essential for effective communication in today's fast-paced digital landscape.

The quality of infographic design plays a crucial role in the effectiveness of health messages. This media emphasizes that while health organizations increasingly utilize infographics, the quality of their design varies significantly (Baxter, 2023). By employing motion graphics as an educational tool, this study seeks to improve the application of research-based design principles among individuals with limited design expertise, thereby enhancing the effectiveness of public health messaging. This is consistent with findings by Cho et al. (2018), who demonstrate that different types of graphics, including gist-based designs, significantly influence the understanding of health messages and decision-making, suggesting that well-designed motion graphics can contribute to improved health outcomes.

The emotional impact of graphic health messages is another critical factor influencing

health attitudes. Research indicates that graphic warnings can evoke strong emotional responses, such as fear, which are associated with an increased intention to change health behaviors. For instance, studies have shown that graphic messages about vaping significantly reduced adolescents' susceptibility to future vaping, demonstrating the effectiveness of emotionally charged visual content in health communication (Cartujano-Barrera et al., 2022). Similarly, Hammond et al. (2012) found that negative emotions elicited by pictorial health warnings could mediate their effectiveness, leading to greater awareness and intentions to modify health-related behaviors.

The acceptance of the alternative hypothesis (H1) and rejection of the null hypothesis (H0) further reinforce the conclusion that motion graphic media serves as an effective educational tool in influencing and enhancing students' attitudes. The intervention not only succeeded in improving knowledge but also had a profound impact on shaping positive attitudes toward the subject matter. These findings provide robust evidence for the utility of multimedia-based interventions in educational settings, particularly for health education, where attitude change is a critical component of behavior modification. The significant impact observed in the intervention group underscores the potential of motion graphic media to engage learners and foster meaningful attitude changes, supporting its broader application in similar educational contexts.

CONCLUSION

In conclusion, this study demonstrates that motion graphic media is an effective tool for improving both the knowledge and attitudes of high school students towards diabetes mellitus. The intervention group, which viewed the motion graphic media, showed a significant increase in knowledge, with the majority of

students scoring "good" in the post-test compared to their pre-test scores. This group's knowledge improvement was notably higher than that of the control group, which showed only minimal gains. Additionally, the intervention successfully transformed the students' attitudes, with all participants in the intervention group shifting to positive attitudes after exposure to the media, contrasting the modest improvement in the control group.

However, this study has several limitations. First, it was conducted in a single school with a specific age group, which may limit the generalizability of the findings to other populations or age groups. Additionally, the study focused solely on knowledge and attitudes without assessing long-term behavioral changes, which are crucial in diabetes prevention. Future research should explore the long-term impact of motion graphic interventions on actual behavior change and expand the study to include diverse age groups and settings to enhance generalizability. It would also be beneficial to compare different types of educational media to determine which methods are most effective in health education.

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REFERENCES

- Baxter, M., & Lonsdale, M. dos S. (2023). Improving the Design of Public Health Infographics Using a Motion Graphic Educational Resource to Enhance Design Principle Application. *Information Design Journal*, 28(2), 141–177.
- Cartujano-Barrera, F., Hernández-Torrez, R., Cai, X., Orfin, R. H., Azogini, C., Chávez-Iñiguez, A., Cruz, E. S., Bansal-Travers, M., Wilson, K. M., McIntosh, S., Ossip, D. J., & Cupertino, A. P. (2022). Evaluating the Immediate Impact of Graphic Messages for Vaping Prevention Among Black and Latino Adolescents: A Randomized Controlled Trial. *International Journal of Environmental Research and Public Health*, 19(16), 10026.
- Cho, Y. H., You, M., & Choi, H. (2018). Gist-Based Design of Graphics to Reduce Caffeine Consumption Among Adolescents. *Health Education Journal*, 77(7), 778–790.
- González-Argote, J., Lepez, C. O., Castillo-González, W., Bonardi, M. C., Cano, C. A. G., & Castillo, A. (2023). Use of Real-Time Graphics in Health Education: A Systematic Review. *Eai Endorsed Transactions on Pervasive Health and Technology*, 9, e3.
- Hapsari, A. S., Hanif, M., Gunarhadi, ., & Roemintoyo, . (2019). Motion Graphic Animation Videos to Improve the Learning Outcomes of Elementary School Students. *European Journal of Educational Research*, 8(4), 1245–1255.
- Khorammakan, R., Totonchilar, S., Pourahmad, M., Tarrahi, M. J., & Ghadami, A. (2023). *The effect of teaching the principles of self-care based on motion graphics on the quality of life and hope of people with covid-19 in home quarantine*.
- Lazard, A. J. (2021). Social Media Message Designs to Educate Adolescents About E-Cigarettes. *Journal of Adolescent Health*, 68(1), 130–137.
- Lonsdale, M. dos S., & Liao, H. (2018). Improving Obesity Prevention Among University Students Through a Tailored

- Information Design Approach. *Information Design Journal*, 24(1), 3–25.
<https://doi.org/10.1075/idj.24.1.02lon>
- Motsumi, M., Bedada, A., & Ayane, G. (2019). The role of moodle-based surgical skills illustrations using 3d animation in undergraduate training. *African Journal of Health Professions Education*, 11(4), 149.
- Nurhayati, F., Azzahra, D., & Lestari, M. D. (2023). Health Education Through Audio Visual Media Effects on Increasing Stunting Prevention Knowledge in Pre-Marriage Couples in Cimahi. *Devotion Journal of Research and Community Service*, 4(5), 1179–1184.
- Oktanizar, M., & Kurniawan, D. E. (2021). Development of Motion Graphic as Education Material for Promoting Shipping Industry Using EPIC Model Testing. *Ijnm (International Journal of New Media Technology)*, 8(1), 27–34.
- Prihaningtyas, R. A., Widjaja, N. A., Hanindita, M. H., & Irawan, R. (2020). Diet dan Sindrom Metabolik pada Remaja Obesitas. *Amerta Nutrition*, 4(3), 191–197.
- Puspita, N., & Syahida, F. (2020). Perbandingan Motion Graphic Dan Leaflet Terhadap Peningkatan Pengetahuan Ibu Rumah Tangga Dalam Menyimpan Obat. *Jurnal Kesehatan*, 11(1), 61–67.
- Sartika, M., Puji Susanti, D., & Medika Suherman Cikarang, U. (2024). Deteksi Dini Kejadian Diabetes Melitis Pada Remaja di SMAN 3 Mangunjaya Kecamatan Tambun Selatan. *PROFICIO: Jurnal Abdimas FKIP UTP*, 5(1), 193–197.
- Silalahi, L. (2019). Hubungan Pengetahuan Dan Tindakan Pencegahan Diabetes Mellitus Tipe 2. *Jurnal Promkes*, 7(2), 223.
<https://doi.org/10.20473/jpk.v7.i2.2019.223-232>
- Ulya, N., Sibuea, A. Z. E., Purba, S. S., Maharani, A. I., & Herbawani, C. K. (2023). Analisis Faktor Risiko Diabetes Pada Remaja Di Indonesia. *Jurnal Kesehatan Tambusai*, 4(3), 2332–2341.
- Wiana, W., Barliana, M. S., & Riyanto, A. A. (2018). The Effectiveness of Using Interactive Multimedia Based on Motion Graphic in Concept Mastering Enhancement and Fashion Designing Skill in Digital Format. *International Journal of Emerging Technologies in Learning (IJET)*, 13(02), 4–20.
- Wicklow, B., Dart, A., McKee, J., Griffiths, A., Malik, S., Quoquat, S., & Bruce, S. (2021). Experiences of First Nations Adolescents Living With Type 2 Diabetes: A Focus Group Study. *Canadian Medical Association Journal*, 193(12), E403–E409.