Visual Attention Analysis of Perspective Images Using the Eye Tracking Method

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ABSTRACT

In this research, eye tracking was applied to observe students' visual attention to three perspective images, each of which has a Region of Interest (RoI). In initial research, it was found that the majority of students faced difficulties in concentrating during the learning process. The aim of this research is to analyze the visual attention of perspective drawings in adolescents in an effort to increase learning concentration. Eye tracking was used as a research instrument to monitor the eye movements of 70 students objectively and in real-time who were guided by giving assignments to look for certain objects. This study showed that in terms of perception speed and focus duration, female participants outperformed male participants. However, overall the level of concentration of teenagers cannot be said to be good. These findings provide important knowledge for educators in creating more effective visual content to improve student concentration and understanding.

Keywords:perspective drawing, eye tracking, concentration, high school students, visual attention, learning

INTRODUCTION

The application of information technology, especially eye tracking, in the world of education has experienced significant growth in recent years. Research shows that eye tracking technology can provide valuable knowledge about learning processes, such as detecting emotions, indicators of cognitive effort, and states of attention, ultimately improving the quality of education.(Kaminskiene et al., 2023),(Schweinberger et al., 2023),(Sáiz-Manzanares et al., 2023).

Medan Cinta Damai Catholic High School, like many other schools, faces challenges in keeping students focused during the learning process. Decreased concentration can be caused by various internal and external factors, such as noise, fatigue, and lack of interest in learning material(Forster & Lavie, 2014),(Z. Wang et al., 2023),(Sibanda & Zhang, 2018).

This research examines the use of eye tracking technology to measure students' level of concentration on perspective drawing. Perspective drawing is a type of drawing that shows the

illusion of depth and space on a two-dimensional surface(Valiyev, 2023). Using perspective drawing in learning can help students understand geometric and space concepts better. However, previous research suggests that students with low levels of concentration may have difficulty understanding perspective drawings(Хиневич et al., 2023). Other research shows that there are differences in the way men and women process information. These differences may influence how they notice and process information in perspective images(Korobeynikova et al., 2022),This technology allows monitoring eye movements, so researchers can ,better understand students' attention patterns.

This research will utilize eye tracking technology to understand how adolescents focus their attention on perspective images when performing an object search task.(Jiang et al., 2020), by recording the user's eye movements and gaze location over time on a given task. Eye tracking determines accurately where and how long a user looks.

LITERATURE REVIEW

Eye tracking

Eye tracking technology plays an important role in education and cognitive psychology by measuring eye movements to decode student behavior, attention, and decision-making processes. This technology allows for the measurement of cognitive effort through eye movements and student activity during tasks such as reading and studying.

Visual Attention

In research(Lindsay, 2020),(Hwang et al., 2023)and others, visual attention in the world of education plays an important role in the teaching and learning environment. These roles influence how students understand and process information. Understanding students' visual attention patterns can lead to improvements in educational materials and teaching strategies.

Perspective Images

Perspective drawings can significantly influence human visual attention by guiding where individuals focus their gaze when viewing an image(Blandfort et al., 2020)and based on research (Zenki-Dalipi & Osmani, 2022)Perspective drawing plays an important role in maintaining students' attention and concentration by creating concrete and abstract ideas for reading.

High School Students

This study took a sample of vocational high school students to investigate their visual attention on national geopark information boards using an eye tracker(Shi et al., 2023)In this study, the age of the sample included as research participants was stated, but the reason why the sample was selected from high school/equivalent, was because the sample had an interest in the world of education and a high sense of curiosity.

METHODS

Types of research

This research uses a quantitative and descriptive approach. A descriptive approach is applied to describe the characteristics and problems related to student concentration, as well as a quantitative approach to measure and analyze data related to student visuals of perspective drawings using the method*eye tracking*.

Population and Sample

Population

This study focuses on Ignatius Cinta Damai Catholic High School students in Medan, which includes both boys and girls. This population was chosen because teenagers at this level of education are known to be active and have high curiosity, with ages between 15 and 18 years.(Wengaard et al., 2017).

Sample

Samples will be taken randomly from the adolescent population with inclusion criteria, namely students from SMA Ignatius Cinta Damai Medan, who have never experienced eye problems and do not wear glasses or contact lenses. Willing to participate as a respondent in research. After a sample of 70 people has been collected, they will be asked to fill out an initial questionnaire, followed by eye tracking recording and filling in the final questionnaire.

Research Instrument

The instruments used in this research are:

A. GazeRecorder application: This application is used to record visual attention data and helps researchers to record eye movements and measure the duration of participants' focus on certain areas of the image(Taim et al., 2023).

B. Google Form Application: The Google Form application is used to collect participant biodata and obtain additional information about the user's experience after using the website.
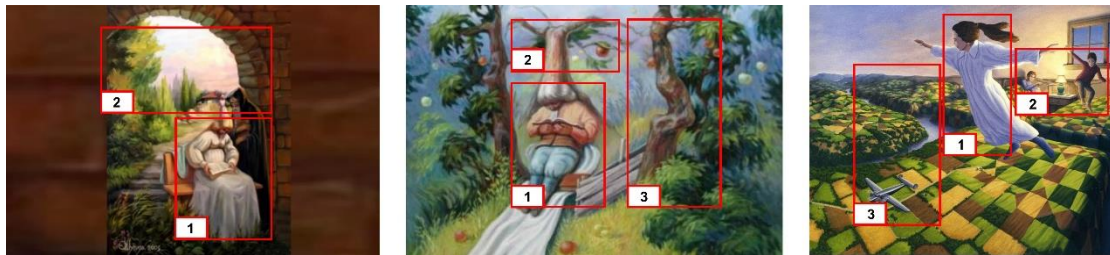
Research Procedures

The research implementation stages can be seen in the following flowchart.
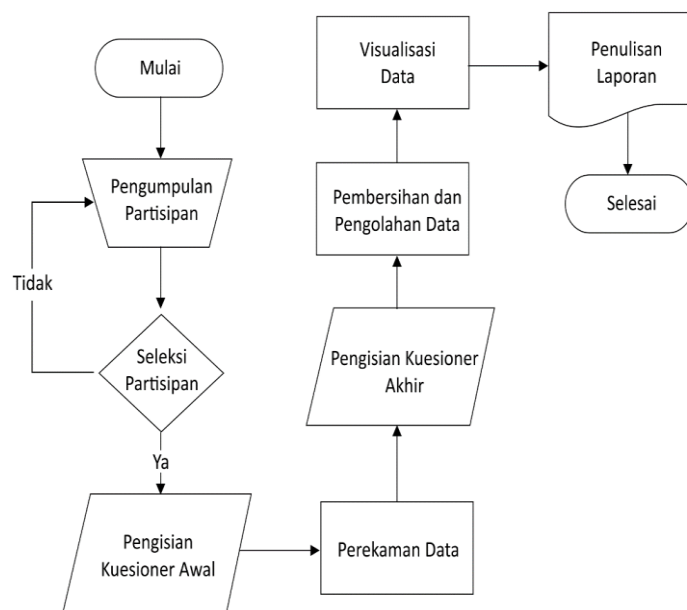
Picture1. Research Flow

RESULTS AND DISCUSSION

Region Of Interest

Picture2. RoI based on perspective drawing

In this research, measuring the level of visual attention was carried out by providing a Region of Interest (ROI)(Hahn & Klein, 2022). Figure 2 is the work of a Ukrainian artist and surrealist named Oleg Shuplyak.(Hailey Hoffman, 2018),(Hidrėley, 2019)and an artist from Canada named Rob Gonsalves(Rob Gonsalves, 2018) used in this research.

Some of the tasks given to respondents are as follows:

a. Perspective drawing 1: Find the face or part of the woman reading the book and when you find one part, stay focused on that part.

b. Perspective drawing 2: Find the eye part or the woman reading a book or the tree part and when you find one of them stay focused on that part.

c. Perspective image 3: Find the part of the woman flying or the part of two men playing on the bed or the part of the scene and when you find one of them stay focused on that part.

1. *Heatmaps*
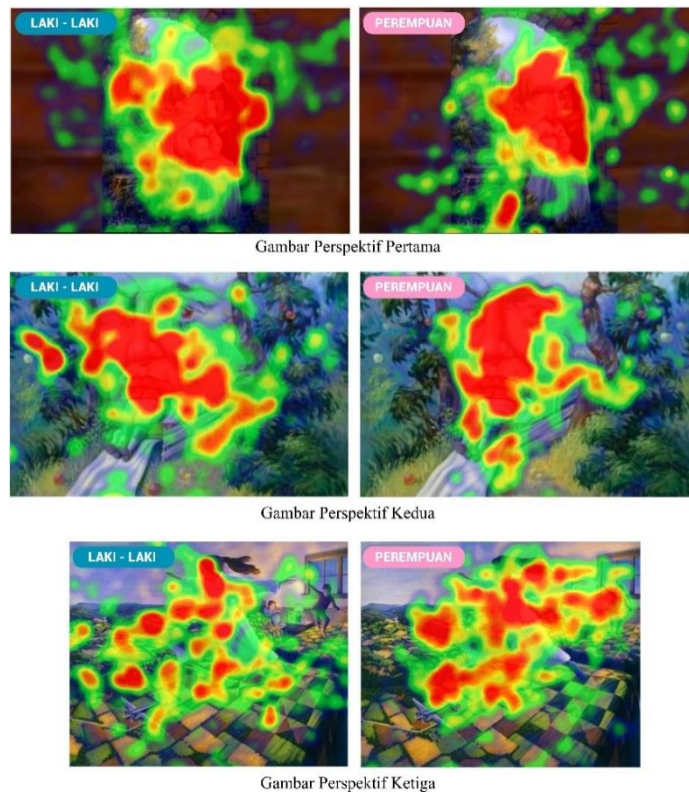
Picture3. Heatmaps for Men and Women.

Figure 3 is a visual representation of the results of heatmaps collected from eye tracking observations of samples and forming certain patterns from gazerecorder.com(Hahn & Klein, 2022)when searching for tasks 1 to task 3 obtained from eye tracking of male and female participants. Each heatmap displays a different color. The redder or yellower the color, the more intensely or frequently the student looks at that area. On the other hand, blue or green colors indicate a lower intensity or frequency of gaze.
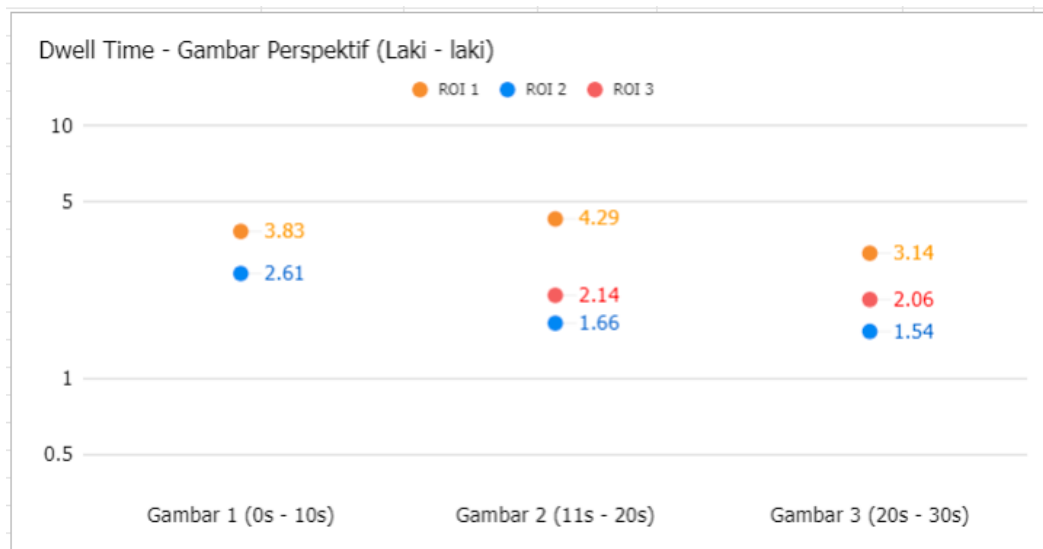
Dwell Time

In this study, each student was given 3 pictures as stimuli, each with a duration of 10 seconds. Referring to the study (Harris et al. 2023), this research uses the eye tracking method to measure the concentration level of high school students. By analyzing large amounts of eye tracking data, previous researchers succeeded in identifying typical dwell time patterns in students with good concentration. The results of this analysis show that students with high concentration tend to allocate their viewing time to the relevant area (ROI) in the range of 68-82% of the total viewing duration on each image. This percentage range was then used as a benchmark in this

researchto categorize the level of concentration of adolescents.If the total dwell time in the ROI is close to 10 seconds, it can be concluded that the participant is truly focused on the area determined by the researcher.
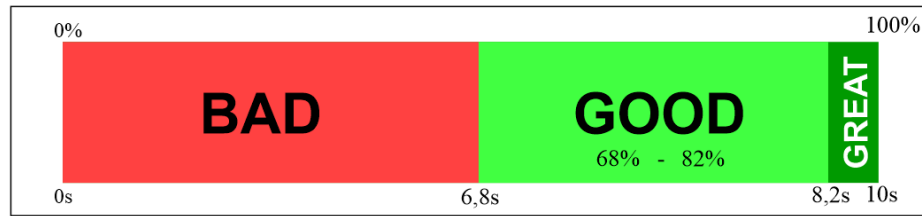
**Picture4. Reference diagram for student concentration percentage**

a.   Male Respondent

Picture5. Male dwell time diagram

Figure 5. visualizes a graph showing the average duration of participants' attention to their RoI or task target from 35 male respondents. This graph shows that samples show concentration levels that tend to be low in relation to the Task RoI that has been determined in each task.

b.   Female Respondent
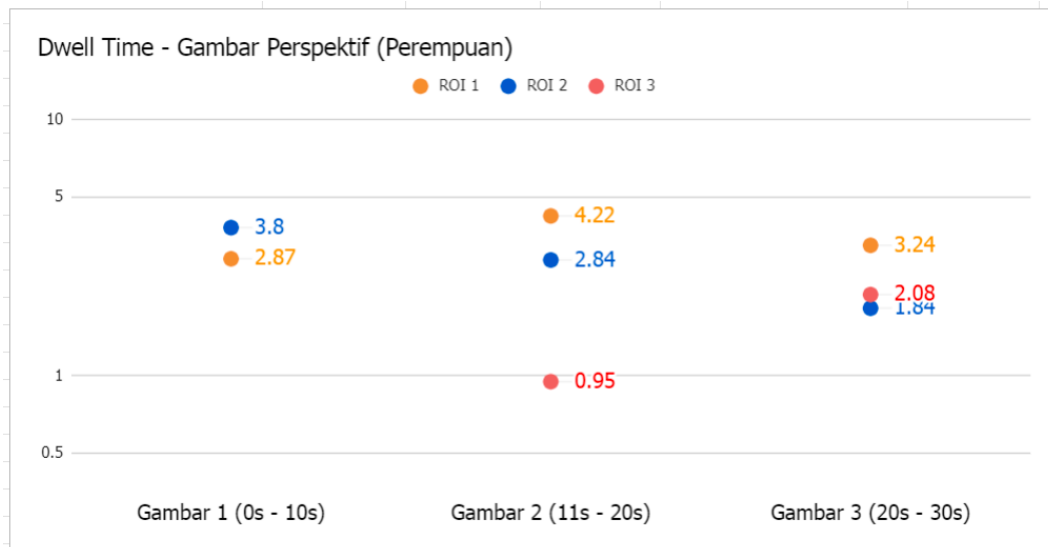
Picture6. Dwell time diagram for women

Figure 6 In perspective image 1 with a duration of 10 seconds, the total dwell time of both RoIs was found to be 6.67 seconds (approaching good concentration) and 3.12 seconds outside the RoI, and increased in perspective image 2 with a total of 8.01 seconds (good concentration) and 1.99 seconds outside the RoI, but in perspective image 3 it decreased again with a total of 7.16 seconds (good concentration) and 2.84 seconds outside the RoI.

First View

a.   Male Participant
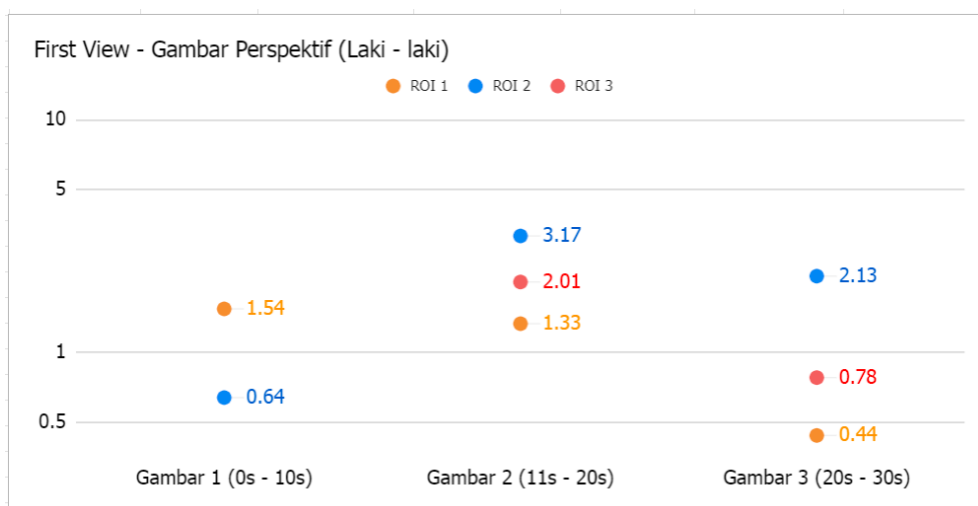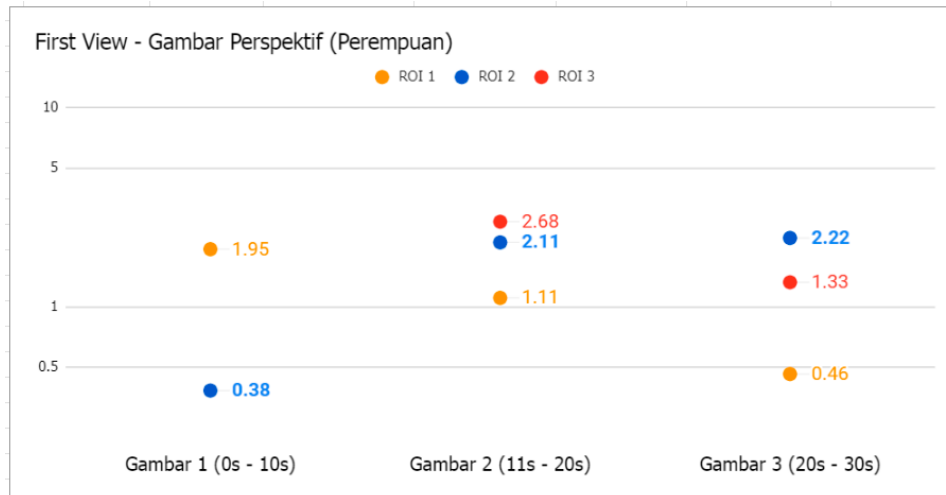

Picture7. First View diagram of a male

In Figure 7. In perspective image 1 the male participant's first focus point is consistently found at RoI 2 at 0.64 seconds. Meanwhile, perspective 2 images are consistently found at RoI 1 at

1.33 seconds. Finally, for perspective image 3 participants tended to focus their attention on RoI 1 at 0.44 seconds.

b. Female Participants

Picture8. Female First View Diagram

In Figure 8. In perspective image 1 the female participant's first focus point is consistently found at RoI 2 at 0.38 seconds. Meanwhile, perspective 2 images are consistently found at RoI 1 at 1.11 seconds. Finally, for perspective image 3 participants tended to focus their attention on RoI 1 at 0.46 seconds.

2. *Respondent Results Perspective drawing*

Picture	Option	Number of Participants	
		Man	Woman
Perspective 1	Woman and face	6	7
	Woman reading a book	29	28
Perspective 2	Woman is reading a book	20	14
	Tree	1	3
	Face	14	18
Perspective 3	Two men were in bed	8	23
	view	3	4
	flying woman	24	8

Table1. Final Questionnaire Results

Based on the data presented in Table 1. Interestingly, of the 70 participants, only 4 participants identified "trees" as objects in perspective drawings. 2 and only 7 participants identified "scenery" as an object in the perspective picture in perspective picture 3.

CONCLUSION

Women were generally quicker to find the first focus point (0.38 seconds) than men (0.44 seconds) and had a longer dwell time on the ROI, especially in the first perspective image. This shows that women's concentration levels tend to be higher. It is hoped that future research can add more variables to increase the benchmark for assessing concentration levels.

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