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The effect of using method timer media on reducing eye fatigue industry workers

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ABSTRACT

The outcomes of an initial research on eye fatigue in the Digital Industry in Yogyakarta, Indonesia revealed that 76% of the employees encountered complaints of eye fatigue as a result of prolonged computer usage. Eye fatigue is considered one of the parameters of office ergonomics in accordance with Indonesian Minister of Health Regulation No. 48 of 2016. One method recommended by this regulation to mitigate eye fatigue is to incorporate short breaks using the 20-20-20 technique. However, a considerable number of workers tend to disregard these recommendations, necessitating the use of media reminders, such as timers, to enforce discipline among workers. The objective of this research was to assess the impact of employing a timer-based media using the 20-20-20 method on the reduction of eye fatigue. The research employed a quasi-experimental design with a nonequivalent control group. In this research, a total of forty workers were selected as the sample population and subsequently divided into two groups: the intervention group and the control group. Sampling was conducted to select a total of 20 workers for each group through purposive sampling. Bivariate analysis was performed using the Sign test and Mann-Whitney test, with a significance threshold of 95% (α=0.05). The results of the statistical tests conducted in both the intervention and control groups revealed a significant difference in reducing eye fatigue, with a p-value of 0.041. This research concludes that the utilization of the 20-20-20 method timer media has a significant effect on reducing eye fatigue among workers.

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1. INTRODUCTION

In the contemporary digital era, computers have become indispensable tools in various office settings, including digital industries, companies, universities, and government agencies, to facilitate daily activities, particularly in the context of work. For the purpose of this research, the digital industry under investigation specifically pertains to the field of animation. According to KEMENPAREKRAF (The Ministry of Tourism and Creative Economy of the Republic of Indonesia), products within the animation industry are categorized into three distinct groups: 2D animation, 3D animation, and stop-motion animation. Upon observing the work equipment employed by workers, it was noted that they utilize computers/laptops, graphic tablets, stylus pens, and animation software for their tasks, with an average daily usage duration of eight hours. Nonetheless, it is important to highlight that prolonged usage of computers or digital electronic devices can lead to the development of various symptoms collectively referred to as computer vision syndrome (CVS) [1], [2].

According to Blehm et al in the research of Venkatesh *et al*. [3], dividing CVS into 4 categories, namely i) asthenopia, which is a tired eyecondition, ii) related to the eye surface such as eye irritation, watery eyes, iii) blurred vision and iv) back, neck and shoulder pain [3], [4]. This research primarily concentrates on asthenopia, also known as eye fatigue, which is the most prevalent cause of CVS. Workers frequently encounter eye fatigue as a consequence of extended computer usage, and it tends to intensify with the duration of computer use [5], [6]. This is consistent with various prior studies that have indicated a substantial correlation between the duration of computer usage and the development of eye fatigue. Utilizing a computer for five hours or more per day, or exceeding 20 hours per week, can elevate the likelihood of experiencing eye fatigue by a factor of 2.6 times [7]. Eye fatigue or asthenopia is a prevalent concern among adults in their work, and this aligns with the growing prevalence of complaints due to the increased utilization of computers and electronic devices [7].

The clinical symptoms of asthenopia or eye fatigue exhibit considerable variation, including manifestations such as double vision, dry eyes, eye pain, and headaches, among others [8]. Nearly 90% of computer users report encountering vision-related issues such as eye fatigue, headaches, dry eyes, and blurred vision [9], [10]. Epidemiological studies indicate that 64% to 90% of computer users experience varying degrees of symptoms related to eye fatigue (asthenopia) [11], [12]. It is important to recognize that these asthenopia symptoms are typically temporary and can be managed. However, if left unattended, they can lead to discomfort and an increase in work-related errors [13]. The American Optometric Association (AOA) has also indicated that the rapid proliferation of technology usage has raised concerns regarding the health and overall well-being of computer users [14].

Data regarding the prevalence of asthenopia among workers who consistently use computers in several countries has been documented as: 86% in Egypt, 68.5% in Mexico, 63.4% in Australia, 53.5% in China, 46.3% in India, and 31.9% in Italy [1], [15]–[17]**.** Meanwhile, in accordance with the AOA, there are up to 1 million new cases of eye disorders in computer users reported annually, with over 10 million eye examinations conducted each year. A report from the Vision Council in 2018 obtained data that 59% of people in America suffer from eye fatigue due to computer usage for two hours or more per day [18] [19]. Continuous computer usage poses vision problems such as reduced eye function, leading to significant physical and occupational burdens. It is estimated that 50% to 90% of all computer users experience symptoms of computer vision syndrome (CVS) [20].

The consequences of extended computer usage typically encompass the following symptoms: eye fatigue (30.9%), headaches (30.9%), double vision (12.9%), watery eyes (10.8%), blurred vision (10.1%), and redness (4.3%) [21]. Consequently, the duration of computer usage significantly influences the occurrence of asthenopia [22]. Furthermore, the impact of eye fatigue stemming from computer monitor screens can lead to a decrease in worker productivity [23].

Based on the outcomes of an initial research conducted in the digital animation industry in Yogyakarta, Indonesia, it was observed that workers typically spend 8-9 hours per day working in front of a computer. Subsequently, it was revealed that 76% of these workers experienced eye fatigue. In accordance with the Regulation of the Minister of Health of the Republic of Indonesia No. 48 of 2016, eye fatigue is considered one of the parameters within the standards of office ergonomics. Consequently, this regulation recommends the adoption of short breaks employing the 20-20-20 method as a means to mitigate eye fatigue. The 20-20-20 method is designed to alleviate eye strain and involves looking at an object beyond the computer screen, positioned 20 feet away, for a duration of 20 seconds after every 20 minutes of computer work [24]. However, in practice, workers are too focused on working so they forget to do the 20-20-20 method. Therefore, researchers are interested in conducting research with an intervention in the form of applying the 20-20-20 method packaged in the form of a timer to remind workers.

This 20-20-20 method timer combines audio and visual, for audio stimuli in the form of recorded guides to remind and guide workers in carrying out the 20-20-20 method while visuals are in the form of steps to apply the 20-20-20 method. With this timer media, it is hoped that workers will become disciplined in applying the 20-20-20 method. And the purpose of this study is to determine the effect of using the 20-20-20 method timer media on reducing eye fatigue in digital animation industry workers in Yogyakarta.

2. METHOD

This research has undergone an ethical review by the Health Research Ethics Committee of the Health Polytechnic of the Ministry of Health in Yogyakarta, Indonesia and it has received Ethics Certificate Number No.DP.04.03/e-KEPK.1/429/2023. The research employed a quasi-experimental design with a nonequivalent control group. The research population encompassed all computer-using workers from three digital animation industries, totaling 40 workers. To ascertain the sample size for this research, the Krejcie and Morgan formula was utilized, yielding a minimum sample size of 37 workers. To account for potential

issues involving workers who might not complete the research, the sample size was increased by 10%, resulting in a total of 40 workers who willingly provided informed consent. In ecological studies have suggested using a sample size (N) of 10 to 20 per indicator [25]. As a result, the sample size for this research is considered suitable. The sampling technique employed in this research was purposive sampling. The researchers based their sample selection on the criterion of workers engaged in the field of design, encompassing both 2D and 3D design work.

In this research, the control group (n=20) was not given an intervention while the experimental group (n=20) was given an intervention. The intervention in this study was the 20-20-20 method timer media as a reminder tool to apply the 20-20-20 method. By using a real time clock, the timer will automatically sound once every 20 minutes to remind workers and guide workers to apply the 20-20-20 method, then the timer will count down for approximately 20 seconds to give workers time to rest their eyes by looking at objects other than computer screens as far as 20 feet. After 20 seconds, the timer will sound again indicating that the break is over and workers can return to work. The timer will continue to sound every 20 minutes for the duration of time it is set for (e.g. eight hours). The 20-20-20 timer method as shown in Figure 1.

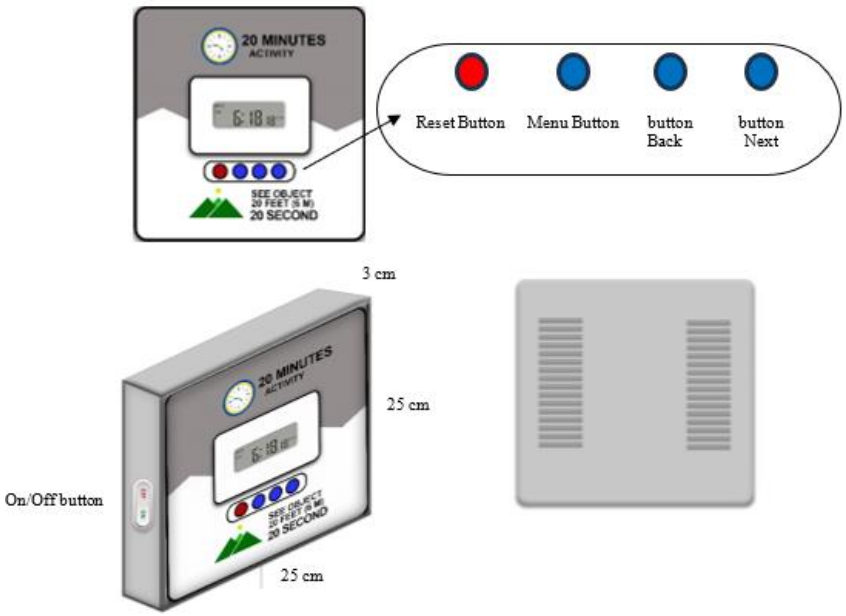

Figure 1. Details of the 20-20-20 method timer media

Figure 1, is the design of the 20-20-20 method timer media where on the front there is writing the steps of applying the 20-20-20 method in black with white and gray background colors so as to clarify the writing. In addition, this media is equipped with 4 simple buttons, namely the reset button, menu button, back button, and next button with these 4 buttons can operate the time, timer, and loud timer sound. While on the side there is an on/off button to turn on the timer media. And on the back of this media is equipped with a spiker to amplify the timer sound so that it can be heard clearly in the workspace.

This 20-20-20 method timer media has been carried out expert judgment by 3 validators in the fields of public health, electronic projects and digital animation. Based on the feasibility test, the 20-20-20 method timer media is suitable for use in conducting research. The 20-20-20 method timer media itself is an audio and visual modified timer. Audio-visual media itself is able to stimulate the senses of hearing and vision so that it contributes greatly to changing people's behavior, especially in the aspects of information and persuasion. The 20-20-20 method timer media was created with the aim of reminding and providing guidance in applying the 20-20-20 method to digital animation industry workers. The 20-20-20 method timer media is applied to remind workers to take a short break as an effort to control eye fatigue. Media for behavior change such as the 20-20-20 method timer media is a stimulus in changing health behavior based on the experience of respondents before and after using the media. This is in line with the health belief model (HBM) theory, namely changes in health behavior with the respondent's perception and belief in the health behavior that has been obtained. This theory focuses on the subjective beliefs of respondents. The existence of experiences within the individual himself and other individuals can foster beliefs about health [12].

Data collection in this study was conducted in 3 2D digital animation industries located in Yogyakarta. The intervention was conducted for two hours at the same time, namely 10.00 a.m - 12.00 p.m at each location for five working days. The 20-20-20 method timer media intervention was only applied to the experimental group after workers worked in front of the computer for two hours. During the intervention, direct observations were made by researchers and research assistants to measure worker discipline in applying the 20-20-20 method with a checklist sheet, while the control group was not given treatment.

Data collection in this research utilized two instruments, specifically a checklist for the implementation of the 20-20-20 method, which was completed by research assistants based on their observations of workers throughout the research. The data obtained from the checklist for the implementation of the 20-20-20 method will be classified as disciplined if the score is ≥8, and as undisciplined if the score is <8. The second research instrument involves the utilization of a visual fatigue index (VFI) questionnaire, which consists of subjective complaints of eye fatigue completed by the workers to gauge the degree of eye fatigue. This questionnaire employs a Likert scale that spans from 1 to 4, and the results are categorized as indicating the presence of eye fatigue if the VFI value is ≥0.4, and as indicating the absence of eye fatigue if the VFI is <0.4 [26], [27]. Consequently, the data scale utilized in this research is ordinal, and non-parametric analysis methods are employed. The test utilized for this research is the sign test, which is employed to assess disparities in the implementation of the 20-20-20 method and a reduction in eye fatigue before and after treatment within the intervention group. Furthermore, to make comparisons between the control group and the intervention group, the Mann-Whitney test is used with a confidence level of 95% (α=0.05).

3. RESULTS AND DISCUSSION

3.1. Subject characteristics

The Table 1, presents the characteristics of respondents in both the intervention and control groups. Following an analysis to assess the comparability of the respondents, the test results indicated a significant difference between the intervention group and the control group, with a p-value of <0.05. As a result, the characteristics of respondents, including age, tenure in the field of animation, and daily work duration, have been identified as confounding variables. However, these variables were not controlled for in this research, which represents a limitation in the research.

Table 1. Respondent characteristics

Characteristics	Intervention		Control		p-value
	n	%	n	%	
Gender					
Male	12	60.0	11	55.0	
Female	8	40.0	9	45.0	0.75
Age					
<20	8	40.0	15	75.0	
>20-30	12	60.0	5	25.0	0.02*
Education					
Senior high School	14	70.0	15	75.0	
S3/D4/S1	6	30.0	5	25.0	0.72
Tenure in animation					
0.5-1 year	5	25.0	12	60.0	
2-3 years	9	45.0	5	25.0	
4-5 years	6	30.0	3	15.0	0.03*
Length of work in one day					
8 hours	18	90.0	8	40.0	
>8 hours	2	10.0	12	60.0	0.001*
Duration of computer use in one day					
≥4 hours	15	75.0	16	80.0	
<4 hours	5	25.0	4	20.0	0.7
Total	20	100.0	20	100.0	

n: number of samples; *p-value<0.05

3.2. Behavioral level of 20-20-20 method implementation

Measurement of worker behavior in applying the 20-20-20 method with a checklist with a discipline category if the score is ≥8 and undisciplined if the score is <8. The data obtained between the intervention group with treatment using the 20-20-20 method timer media and the control group without treatment. Based on Table 2, the score of worker behavior in applying the 20-20-20 method shows that the average score obtained in the intervention group is 3.25 for a minimum score of 2.70 and a maximum of 4. After being given treatment with the 20-20-20 method timer media, there was an increase in the average behavior score

to 8.03 with a minimum score of 6.80 and a maximum of 9.60. While in the control group the initial measurement behavior score was at least 2.50 and a maximum of 3.80 and the final measurement data showed that there was not too much change in behavior score with a minimum score obtained of 3.80 and a maximum of 4.50. Results of mann-whitney test analysis between the intervention group and the control group on behavior scores after the intervention with the 20-20-20 method timer media for five working days obtained a significance value of 0.00 ($p<0.05$), so it can be concluded that there is a significant difference between the intervention group and the control group. So that there is an effect of applying the 20-20-20 method timer media in the behavior of workers in applying the 20-20-20 method as an effort to control eye fatigue.

Table 1. Analysis of differences before and after timer media treatment on 20-20-20 method implementation behavior

Variable	Mean Pre±Post	Min value Pre±Post	Max value Pre±Post	SD Pre±Post	p-value
Intervention 20-20-20 Method Implementation Behavior	3.25±8.03	2.70±6.80	4±9.60	0.40±0.84	0.00*
Control 20-20-20 Method Implementation Behavior	2.98±3.68	2.50±3.80	3.80±4.50	0.31±0.36	

SD: standard deviation; *p-value<0.05

3.3. Eye fatigue level

Measurement of eye fatigue in workers is done by filling out a visual fatigue index (VFI) questionnaire with the category of experiencing eye fatigue if the score is ≥0.4 and not experiencing eye fatigue if the score is <0.4. Based on Table 3, eye fatigue scores experienced by workers, the average score in the intervention group before treatment was 0.43 with a minimum score of 0.30 and a maximum of 0.62. After being given treatment with the 20-20-20 method timer media, there was a decrease in the average eye complaints to 0.36 with a minimum score of 0.28 and a maximum of 0.52. While in the control group the initial measurement behavior score was a minimum of 0.30 and a maximum of 0.65 and the final measurement data showed that there was no change in value. In the results of the mann-whitney test analysis between the intervention group and the control group on the eye fatigue score experienced by workers after applying the intervention with the 20-20-20 method timer media for five working days, a significance value of 0.041 ($p<0.05$) was obtained, so it can be concluded that there is a significant difference between the intervention group and the control group. So that there is an effect of applying the 20-20-20 method timer media in reducing eye fatigue experienced by digital animation industry workers.

Table 2. Analysis of differences before and after timer media treatment on decreased eye fatigue

Variable	Mean Pre±Post	Min value Pre±Post	Max value Pre±Post	SD Pre±Post	p-value
Intervention Decreased Eye Fatigue	0.43±0.36	0.30±0.28	0.62±0.52	0.06±0.05	0.041*
Control Decreased Eye Fatigue	0.43±0.43	0.30±0.30	0.65±0.65	0.09±0.10	

SD: standard deviation; *p-value<0.05

3.4. Effect of 20-20-20 method timer media on reducing eye fatigue

According to the research results, the activation of the 20-20-20 method timer media had a significant effect on reducing eye fatigue in the intervention group compared to the control group. This discrepancy can be attributed to the intervention group workers consistently adhering to the 20-20-20 method, whereas the control group often forgets to apply it. Consequently, the intervention group had longer periods of rest for their eyes when implementing the 20-20-20 method, as opposed to when they did not apply it [28]. Eye fatigue is a common issue that arises from extended computer usage. The outcomes revealed that workers typically spend ≥4 hours continuously in front of a computer during their daily routines, and on any given day, they work for eight hours or more. Consequently, workers are at a heightened risk of experiencing asthenopia. This is supported by the fact that the average eye fatigue score in the intervention group prior to the intervention was 0.43, which was not significantly different from the control group's score of 0.43.

The implementation of the 20-20-20 method timer media over five working days has an influence on workers' behavior in adhering to the 20-20-20 method. This is evident in the average behavior score for the intervention group, which increased from 3.25 before treatment to 8.03 after treatment. Based on the

research data, it is apparent that as workers become more disciplined in applying the 20-20-20 method, the complaints of eye fatigue experienced by workers decrease. The average eye fatigue score prior to the intervention was 0.43 (indicating the presence of eye fatigue), but it decreased to 0.36 (indicating the absence of eye fatigue) after the intervention.

The utilization of the 20-20-20 method timer media over five days of computer work provides a response to the hypothesis posited in this research, which suggests that there is an impact of employing the 20-20-20 method timer media in reducing eye fatigue among Digital Animation Industry workers in Yogyakarta. This research aligns with the outcomes of several researchers who assert that regular adherence to the 20-20-20 method is effective in mitigating the risk of CVS [1], [4], [29]–[31]. Furthermore, the 20-20-20 method has been found to be effective in alleviating dry eye symptoms as well [11].

4. CONCLUSION

The conclusion obtained from this study is that the 20-20-20 method timer media is a reminder-based media that is able to remind workers to apply the 20-20-20 method so as to reduce eye fatigue experienced by workers. This is in accordance with the research data which shows a difference in eye fatigue scores before and after intervention with the 20-20-20 method timer media with a significance value of 0.041 ($p<0.05$) which means that the 20-20-20 method timer media has an effect in reducing eye fatigue. For this reason, digital industry workers are advised to always apply the 20-20-20 method when working in front of a computer. Meanwhile, further research can conduct similar research by controlling confounding variables such as age, length of service in the animation field and length of work in one day.

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