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Awareness of Pre-Service Teacher on Digital Eye – Strain

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Abstract. Eye defects are the most common health problems for school-age children. Eye defects affect not only the health but also the academic success of the student. Spending too much time with tablets and computers is leading to a *deterioration* in vision. It seems possible to take prevention with early diagnosis of the symptoms of eye problems. Pre-service teachers might be aware of the symptoms of eye problems and take the necessary precautions with early diagnosis. The purpose of this study is to investigate the awareness of pre-service teachers about digital eye-strain symptoms. Participants are twelve pre-service teachers studying at ESOGU Education Faculty in the fall semester of the 2020-2021 academic year. Phenomenological design was used in the study. According to the results of the study the pre-service teachers stated the general eye defect symptoms, listed the possible negative effects of these defects on students' academic life, and described what teachers should do in such cases. The pre-service teachers couldn't distinguish between digital eye-strain and general eye defects. It is suggested to provide pre-service and in-service training opportunities for pre-service teachers and teachers about digital eye-strain.

Keywords. Computer, digital eye-strain, tablet, phone.

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The rapid change in people's lives in the digital age, due to the advances in science and technology has also shown itself in education. Information technologies, called Web 2.0, are used in accordance with the curriculum to gain certain skills by encouraging students and teachers to use digital tools more. Today, a great majority of the society can easily access technological tools such as telephone, computer, TV and especially the Internet in their homes, schools and workplaces. Developments in information and communication technologies have also diversified the ways of accessing information of students to learn and practise individually out of the classroom environment. Distance education systems with technological tools for communication, access to information and information sharing are used actively in educational life when necessary or for compulsory reasons and their correct and effective use provides many benefits. However, their improper use brings about a lot of negativity that affects the children the most. In the last ten years, the use of digital technology has increased rapidly, especially due to mandatory reasons such as the pandemic, and children have started to spend a large amount of time with the internet, television, computer, smart phone and other technological tools (Gelişli, 2015; Özgöl, Sarıkaya & Öztürk, 2017; Tuncer & Taşpınar, 2008; Ulusoy & Bostancı, 2014; Zehir et al., 2019).

Since it has become a usual routine for children to spend most of their time (8-12 hours a day) attending e-courses in front of computers or mobile screens with no specific guidance, these devices cause damage by emitting short high-energy waves that can penetrate the eye. Eventually contribute to photochemical damage to retinal cells. Hence, children become vulnerable to a variety of eye problems known as Digital Eye Strain (DES) or Computer Vision Syndrome (CVS) (Madhan, 2009). DES or CVS is directly proportional to the duration of digital screen exposure and the fact that the prevalence of computer users is estimated to be 50% or more (Sheppard & Wolffsohn, 2018) is worrisome.

Being the riskiest age group, children may not complain as early as adults; therefore, it can be assumed that their diagnosis may be delayed. Furthermore, promotion of unlimited e-classes for such children has put a clear strain on their already overloaded eyes, unwittingly placing them at a higher risk of DES due to the current unregulated e-learning trend (<https://yoursightmatters.com/are-electronic-devices-affecting-my-vision/>). DES is managed non-pharmacologically and pharmacologically; while the former includes proper lighting, careful positioning of the digital device, adjusting image parameters (resolution, text size, brightness) and giving breaks, the latter involves artificial tears as a strategy (Sheppard & Wolffsohn, 2018).

In 2019, the MoNE digital education platform eba has become a technological tool on a global scale with over 10 million downloads and over 1 billion clicks in a month. According to Turkish Statistical Institute (TUIK) data, the rate of internet use among individuals aged 16-74 in Türkiye in 2020 increased by 3.7 points compared to the previous year and reached 79.0%. The rate of households with internet access from home increased from 88.3% to 90.7%. The distribution of the average number of days per month of television broadcasts watched on phones, tablets and computers in Türkiye by age was determined to be average 1.1 days per month for those aged 15-24, 0.9 days for those aged 25-34, 0.7 days for those aged 35-44, 0.3 days for those aged 45-54, and 0.2 days for those aged 55-64 day, which shows that the use of digital technologies has increased. Considering the studies on the duration of using information technologies, it is seen that computers with internet connection are the most used tools (Mustafaoğlu et al., 2018; Gökel, 2020; Sırer, 2020; Tezcan & Aslan, 2000). Due to compulsory reasons such as pandemics, the increase in the use of digital devices leads to certain problems in students, one of which affecting health is eye strain. Long-term close exposure, increased cognitive load, screen usage styles affect digital eye disorders complaints (Agarwal, Goel, & Sharma, 2013; Koçoğlu et al., 2020; MEB, 2020; Ostrovsky et al., 2012; Özdiñler et al., 2019; Yamamoto & Altın, 2020). Some of these eye problems are refractive error, amblyopia, strabismus, colour blindness (Akbulut, 2013; Kalyoncu et al., 2011). In their study, Xu et al. found eye strain to be associated with daily time spent on digital devices (Xu et al., 2019).

Being exposed too much to digital tools tires the eyes the most. With close distance and light intensity, the eye muscles get tired excessively, which causes digital eye strain (DES). Digital eye strain syndrome, better known as computer vision syndrome (CVS), is defined as a series of ocular surface distress and vision problems that occur during or after computer use. DES or CVS (asthenopia) is a symptom complex that can occur as eye pain, burning in the eyes, stinging, light sensitivity, fatigue, dry eyes, itching, turbidity, watering and headache, and adversely affects the quality of life (Bostancı, 2016; Sheppard & Wolffsohn, 2018).

According to Sheppard and Wolffsohn (2018), it is always better to prevent DES cases than to follow-up it. There are studies investigating the effects of variables such as the electronic devices used, the average daily usage hours, the distance from the digital screen, the use of glasses that will affect posture and ocular symptoms, the frequent changes in the prescription of glasses, and the use of smartphones when the lights are off at bedtime on DES. It is recommended that the optimum focal distance of 30-40 cm for reading and writing should be 50-70 cm for the computer monitor (Rempel et al., 2007). Smaller digital devices such as mobile phones are usually kept 20–30 cm away from the

eyes, which promotes conditions for digital eye-strain (Ichhpujani et al., 2019). Long et al. (2017) emphasized that after 60 minutes of reading from a smartphone, the viewing distance became closer and the symptoms of eye strain got more pronounced. In yet another study, it was stated that improper posture causes excessive strain on the eyes, hunching of the back and pain in the neck and back muscles (Breen et al., 2007).

Although it is recommended that young people aged 8-16 should not have more than daily two hours of screen time, studies have shown that young students in this age group spend 840-1680 minutes per week using digital devices (Ichhpujani et al., 2019). Accelerated myopia is just one of many health complaints and it has been emphasized by researchers to be caused by various factors such as excessive screen time, excessive use of technology as teaching aids at school, increased homework load and unlimited entertainment time (surfing the internet, social networking, playing video games and watching movies) (Gentle, 2009; Ichhpujani et al., 2019).

The findings of Tosini, Ferguson, and Tsubota (2016) show that clarity of high-definition television screens, laptops and tablets is easier to feel for the eyes than older screens, many screens are backlit and emit wavelengths of blue light or high-energy visible light (HEV: High Energy Visible Light), the eye is sensitive to this blue light and this exposure, causing cumulative damage over a period of time, can increase the likelihood and severity of eye disorders (eg, age-related macular-yellow spot disease-degeneration and cataracts) (cited by Ichhpujani et al., 2019).

Any defect in the eye, the brightness/feature of the screen, the distance to the screen, the brightness of the environment, the digital effect time all increase the risk of digital eye strain. According to the literature, 75% of those who spend more than 6 hours a day in front of a screen experience eye problems such as eye strain, burning, stinging, redness, and headache. When looking at the screen for a long time and intently, the number of blinks is also reduced; that is, while blinking 12-16 times per minute in a normal situation, this number may decrease to 5-6 times in front of the screen. This also leads to dry eyes. Reading the articles on digital sources makes the eyes about 25% more tired. In a study, the most common symptoms of eye diseases and visual defects in students are determined to be difficulty in seeing, headache, watery eyes (Yaramış & Karataş, 2005). In another study, as a result of the examination of suspicious cases by the ophthalmologist, 34 (68%) of the juvenile subjects were found to be sick (Aydın et al., 2002; Azizoğlu et al., 2017; Durmuş et al., 2000; Kaya, 2020; Mustafaoğlu et al., 2018; Oguzhanoglu et al., 1996). Kaya (2020) emphasized that these symptoms are an important condition that affects students' attention and academic performance.

The Vision 2020 program of the World Health Organization determined the control of visual impairment and blindness in children as a priority issue (Gilbert & Foster 2001, Morgan and Rose, 2005). Visual disorders in childhood should be recognized and treated at an early stage; otherwise, eye defects may cause bigger health problems over time (Kırağ & Temel, 2016). The ability to see is very important for the development of children, because children interact with their environment by seeing. Therefore, vision problems cause not only eye health of students, but also regression in their cognitive functions, inadequacy, difficulty and limitation in language and development areas, as well as motor and social developmental delays. Accessing and perceiving information that the student cannot see can make it difficult to establish a cause and effect relationship. It can also cause problems such as low self-esteem, denial, anxiety and depression in children due to their inadequacies in terms of vision compared to normal individuals. Lack of attention at school, reluctance towards lessons, fatigue, late learning to read, perception disorders, low grades and behavioural disorders may develop due to visual impairment. Early diagnosis and treatment of visual disorders ensures that children both increase their school success and improve their social interactions with the individuals around them. This process is determined when the child starts school and it is noticed by the teacher that s/he cannot see the writings on the board (Kızılaslan & Sözbilir, 2018:33, Koçak et al., 2016).

Teachers have a very important role in detecting vision problems in school-age children. In an interview of Murat Yıldırım with Ophthalmologist Specialist Surgeon Dr. Mahmut Ecel, Dr. Ecel stated that eye disorders in children can sometimes be overlooked, that teachers are the ones who can diagnose eye disorders in children most easily and therefore they have a lot of responsibility. Also, as an answer to Murat Yıldırım's question "*Do tablets and computers increase eye discomfort?*", Dr. Ecel said that myopia eye disease is a frequently encountered situation in children who watch television closely and spend a long time with their phone and tablet, and that in such cases, wearing glasses with minus glasses, watching the television from at least 3 meters away, using tablet and phone not more than half an hour may prevent further progress of the existing problem.

According to Dr. Ecel, eye examination is very important in the early period because late diagnosis of myopia and astigmatism may cause a risk of amblyopia and high eye-glasses number. It is natural that the frequency of myopia increases with the increase in the frequency of use of tablets and phones, so children should be prevented from long-time tablet exposure and unconscious use. If a child has a long reaction time and tends to squint while reading, the teacher should focus on this situation and encourage the family for the child's referral to an ophthalmologist. With such attention, sensitivity and knowledge of the teacher, s/he may have made the early diagnosis of many diseases

from cataracts to hidden eye tumours. For this reason, the sensitivity of teachers in this regard is very important, and teachers should also be a role model for children to minimize the time they spend with mobile phones, computers and tablets (www.ilkh Haber-gazetesi.com/roportaj/gozde-ilk-teshis-i-ogretmen-yapmali-h28950.html).

Considering the seriousness of the situation, the knowledge, sensitivity and awareness of the pre-service teachers on this subject are important in terms of the mass they interact with. It is thought that teachers will make a significant contribution to their students' development by informing them about digital eye strain and helping them gain positive attitudes and behaviours. Therefore, teachers' knowledge, awareness and attitudes about digital eye strain are important in raising awareness of both students and society. In this respect, it was aimed in this study to determine whether the pre-service teachers have sufficient awareness to diagnose the symptoms of digital eye strain and to know what to do, and it is thought that the findings will contribute to the future studies and the content of the pre-service academic training of the candidates on this subject.

Method

Research Model

This research, which aims to determine awareness of pre-service teachers' eye defects/digital eye strain symptoms in primary school children, is a qualitative study. Qualitative research aims to research and understand social phenomena in their environment. It reveals the perceptions of the individuals in the sample and tries to understand the outside world with their perspectives (Yıldırım, 1999). The research was designed as phenomenology, one of the qualitative research approaches. Phenomenological studies describe the individual experiences of participants who have experienced a phenomenon.

Study Group

Pre-service teachers' opinions were evaluated within the scope of the study because these pre-service teachers are seen as the group that can diagnose the digital health problems of the digital generation at the earliest period and receive the necessary training before the service. The study group of the research consists of 12 pre-service teachers studying at the faculty of education, determined by convenience sampling method.

Data Collection Tools

In this context, semi-structured interviews were used as the data collection method in the research. Prior to the interview, an interview form suitable for the semi-structured interview technique was developed and approval was obtained from an ophthalmologist regarding the interview questions. While forming the interview questions, the existing studies in the literature on student digital eye defects were examined and questions were asked to the participants about their experiences regarding the symptoms of childhood eye defects. With 3 open-ended questions, the pre-service teachers were expected to express their views on how to understand the symptoms of digital eye defect in students, how much eye defect reflects on students' academic life, and what teachers should do about eye defects.

Data Analysis

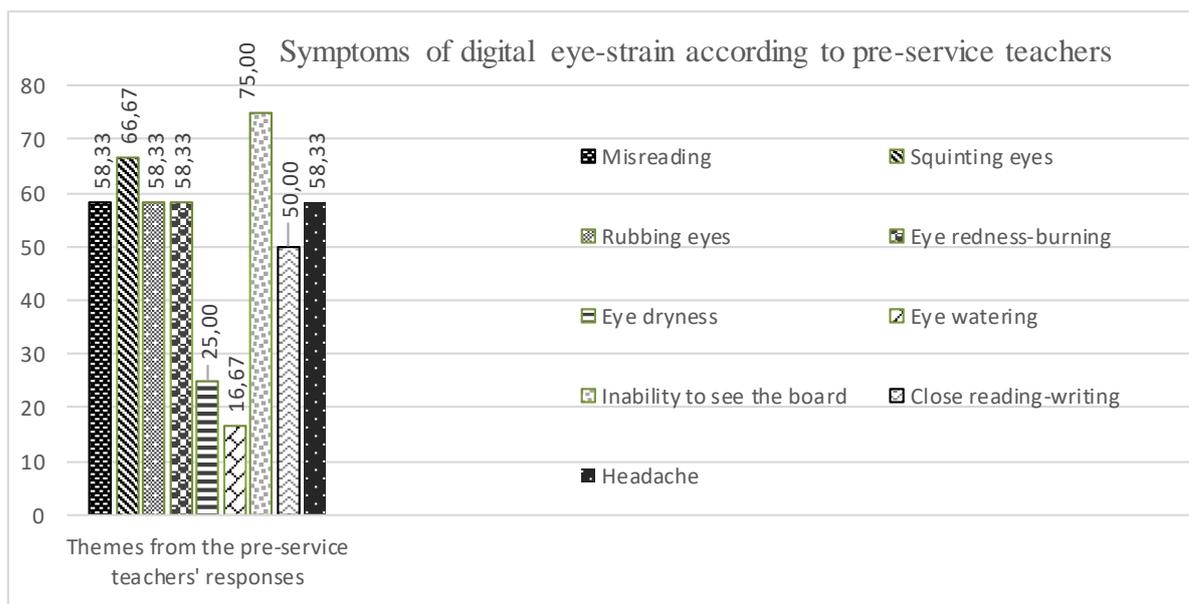
The data were collected from the pre-service teachers within the scope of distance education and analysed using the content analysis technique. In the content analysis process, the stages of data coding, creating the themes, organizing the themes and interpreting the findings were performed. At the last stage, the findings of the study, which were combined under the organized themes, were interpreted. The participants were coded as A1, A2, A3, ..., A12. In order to ensure the internal validity of the research, the participants were asked to state their opinions in detail and sharing the results with the participants, their opinions were taken again. The questions and answers were reviewed by the researchers in their final form.

Results

In this section, the findings and comments about the pre-service teachers' understanding of digital vision problems in students are given. The findings were examined in three themes: digital eye strain (DES) symptoms in students, reflection of eye strain on academic life, and what a teacher should do against digital eye strain.

Symptoms of Digital Eye-Strain According to Pre-Service Teachers

Pre-service teachers were asked about the symptoms of eye strain they might encounter in their classrooms. They answered this question by stating possible eye problems (Graph 1).



Graph 1. Pre-Service Teacher Descriptions of Symptoms for Digital Eye-Strain.

Below are some of the pre-service teacher responses.

A3. *If the student has difficulty in reading the texts, squints or makes too much effort to read, I can think that the student has an eye defect. In such a case, I write on the board and ask the student to read this text from 3 meters away, and in this process, I observe the student while reading the text.*

A5. *If a student is constantly rubbing their eyes, squinting while trying to look at the board, or blinking when something is reflected on the projection in the classroom, s/he may have an eye problem.*

A6. *We can understand it from the student's saying that he cannot see the board even though it is within his sight, his squinting while reading something, his eyes getting tired or reddened.*

A7. *If a student squints while looking at distant objects, gets too close to see small objects or writings, makes incorrect readings, or there are line or word shifts in the texts he reads, and if he has to follow the text with his hand or a pencil, this might show symptoms indicating visual impairment.*

A9. *As well as blurred vision, severe eye pain, headache, nausea, red eyes, other symptoms like eye strain, itching, redness, dryness, burning, watering, difficulty focusing, double vision and impaired colour perception indicate the presence of an eye disease. When children read a text or something, they read by getting very close to the book. When they write on the board, they stick to the board. They read inaccurately even though they sit at the first row, or say they can't see. They squint*

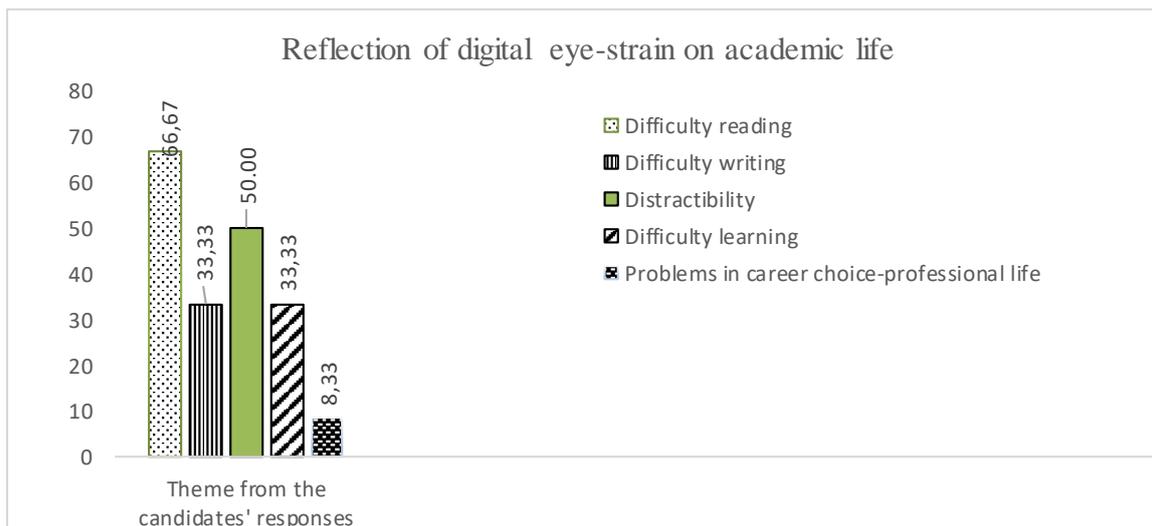
their eyes, bring their chair closer to the television when the teacher shows something in the classroom, etc.

A10. When people look at digital screens for a long time, they experience eye discomfort and vision problems, and the level of discomfort increases with the amount of digital screen use. This situation is also more common in students because students look at computer and mobile phone screens more than necessary. They may also suffer from eye strain, itching, redness, dryness, burning, watering in the eyes, blurred or double vision, slow focus, impaired colour perception, and headache.

As it can be understood from the statements, the pre-service teachers can understand eye problems in children from not being able to see the board, misreading, and abnormalities in the eyes (redness, watering, squinting, closing, blinking, rubbing, etc.). However, the most prominent feature of digital eye strain is dry eyes because when looking at the digital screen for a long time, the blink reflex in the eye decreases, and the eye becomes dry and stinging with a decrease in teardrops. As a result, there is a feeling of stinging, redness, burning and foreign body in the eyes. Patients have complaints that their eyes get tired very quickly (www.ilkh Haber-gazetesi.com/roportaj/gozde-ilk-teshisi-ogretmen-yapmali-h28950.html). According to the findings of the research, it is seen that the pre-service teachers' determinations about general eye defects are quite accurate, but they do not know the specific symptoms of digital eye strain.

Reflection of Digital Eye-Strain on Academic Life

When asked how eye strain is/will be reflected in the academic life of the student, the prediction of most of the pre-service teachers is that academic success will decrease. Possible problems related to the reflection of digital eye-strain on academic life are given in Graph 2 with examples of the answers by the pre-service teachers below the graph.



Graph 2. Reflection of Digital Eye-Strain on Academic Life.

A2. *Children with eye defects always want to sit in the front row because they can't see the board from the back rows. Sometimes they may feel different from their other friends because they wear glasses.*

A3. *If a student mistypes or writes too big or small when she wants to write something, I think this behaviour is not normal.*

A4. *Or there may be students who do not want to wear glasses. They may think that they will be teased for wearing glasses, and therefore their school life may be negatively affected.*

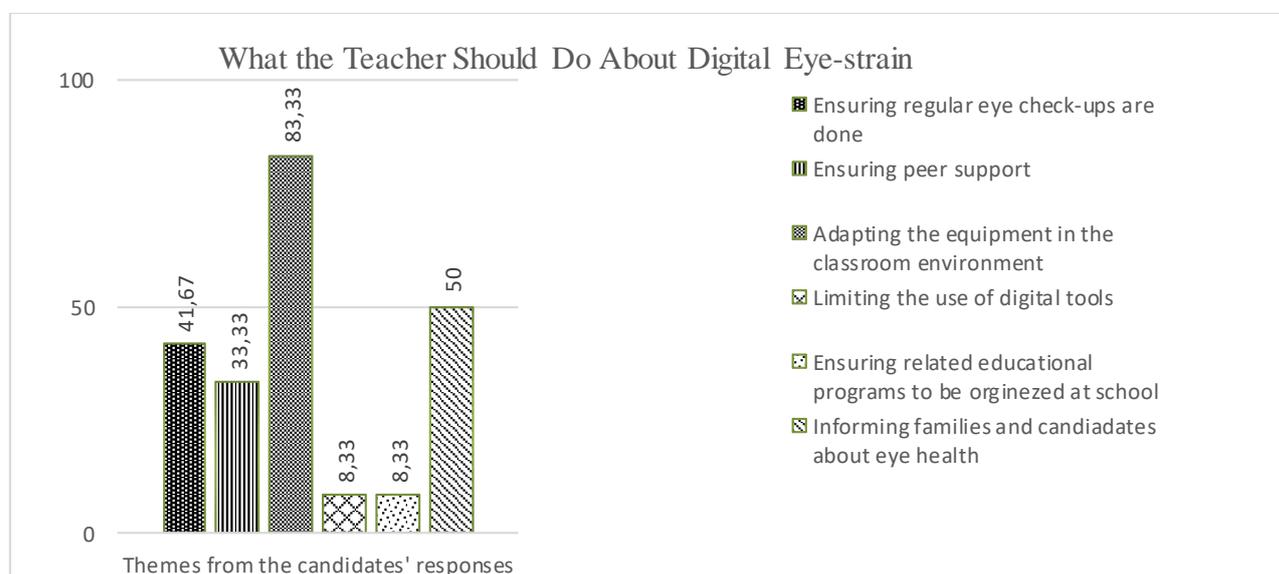
A7. *As a person with amblyopia, astigmatism and myopia problems, I can say that it is a disadvantage in sports and art activities as well as in academic life. In addition to the child's abstaining from many sports activities, the risk of injury in the activities he joins is also quite high.*

A8. *If a student miswrites what he sees on the board into his notebook, cannot concentrate on the lesson, has a headache, skips lines while reading a book or text, constantly gets help from his friends while writing, has problems like not being able to notice the things in front of his eyes, looking at the same place for a long time, that student should definitely have an eye check.*

The responses of the pre-service teachers show that similar definitions are made for the effects of general eye defects on academic life, which are theoretically true. However, stinging in the eyes and head/spine pain accompanying digital eye-strain are important factors that reduce students' participation in the class and their attention/concentration time. Also, the eyes getting tired faster than normal, indifference to lessons and visual perception problems are significant (Sheppard & Wolffsohn, 2018).

What Teachers Should Do in Class about Digital Eye-Strain

When asked what to do in the classroom about digital eye-strain, the foresight of most of the pre-service teachers includes the precautions after the problem occurs. Rather than protective measures such as reducing and restricting digital interaction, distance control, eye rest activities, etc., instructional practices that support the student's vision are emphasized.



Graph 3. What the Teacher Should Do About Digital Eye-Strain.

The themes out of pre-service teachers' expressions regarding the practices that teachers should do regarding digital eye strain are given in Graph 3. Below are some of the pre-service teacher responses.

A3: *To check it up, I write on the board and ask the student to read this text from 3 meters behind, and in this process, I observe the student while reading this text. I also want him to close his right and left eyes in turn and read. I think vision examinations should be done every year before and after starting primary school. Families can be made aware of this issue with seminars in schools and educational programs in the media. In addition, the physical environment of the classroom should be arranged according to the student's visual defect so that he can benefit more from education.*

A4. *The student can sit in the front rows and the teacher can constantly inculcate the child about whether s/he sees it or not so that s/he can get the best out of the lesson. The teacher can also contact the student's family and talk about the need to see a doctor.*

A5. *The student should be seated in the front row to enable seeing the board comfortably. When the projector is to be used, the lighting of both the computer and the classroom should be brought to the appropriate conditions so that the student is affected minimally.*

A6. *The most effective method may be to place the student in a row at a distance where s/he will not have difficulty seeing. If the student cannot see near, s/he should be seated in the middle rows, and if s/he cannot see far, s/he should be seated in the front rows. If we realize that the student is still having difficulty even if s/he is seated in the front, we can try to minimize this difficulty by seating an understanding and helpful student next to the student.*

A7: *The teacher, mastering the signs of eye defects, observes the students and may even occasionally give them small tests. Also, parents should be contacted to encourage periodical doctor check-ups. Besides, a suitable seating arrangement should be provided for children with lazy eye or sensitivity.*

A8. *The teacher can sit the student with eye defects in the front row even if s/he has not yet gone to the doctor's check-up. Eye defects should be taken into account during the seating arrangement in the classroom. The teacher should use the board conveniently writing in a size that students can see with pens of distinctive colour. For the eye health, students should not have continuous and long readings. Events, announcements, rules, etc. to be hung or written on the board should be written in large fonts.*

A9. *First of all, the teacher should inform the student's family about this situation. In the class, s/he has to be set at the first row in front of the blackboard. The teacher should avoid using a digital screen in a very bright or dark environment for a student with an eye defect. If s/he is to watch something in the classroom, the student with visual impairment should sit at a distance of approximately 50-70 cm from the digital screen.*

A12. *The first thing to do in the classroom is to explain the causes of eye defects.*

Pre-service teachers indicated possible precautions in the class for general eye defects. There was no opinion other than one pre-service teacher regarding the prevention of digital eye-strain and use of digital tools in a healthy way.

Discussion and Conclusion

The research results show that the pre-service teachers can describe the symptoms of general eye defects, list the possible negative effects of these defects on academic life, and describe what the

teachers should do to solve the problem. However, they cannot fully distinguish between digital eye-strain and general eye defects. Eye defects caused by digital exposure can be prevented with a conscious and controlled orientation, and students can be informed of their harm.

Many visual problems can be encountered in children during the school today, vision disorders caused by digital tools are at the forefront of eye problems. This situation affects negatively both the quality of children's life and their school success. Along with the fact that digital screens have become indispensable in our lives, health problems that may develop due to the use of such screens have also emerged. In addition to muscle and joint problems such as numbness in the fingers and neck pain, visual and ocular problems are among the problems that may develop due to digital tool use. Digital eye-strain syndrome, also known as computer vision syndrome, is defined as ocular surface distress and vision problems that occur during or after computer use. The most frequently reported symptoms by patients are; eye fatigue, itching, redness, dryness, burning, watering; blurred or double vision, slow focus, impaired color perception, and headache. When school-age refractive errors were examined, it was determined that 8% of 650 students in the study of Kırağ and Temel (2016), 12.4% in the study of Ceylan and Turan (2009) and 8.3% in the study of Işıklı et al. (1993) had a refractive error. According to the research of Yaramış and Karataş (2005), the symptoms of eye diseases seen in students are respectively; difficulty in seeing when looking near (9.8%), difficulty in seeing when looking away (8.5%), eye strain (5.2%) and headache (1.5%). In a study, it was determined that the most common symptoms of eye diseases in students were difficulty seeing, headache and watery eyes. It has previously been shown that the use of tablets for more than one hour per day affects tear break-up time. It has also been reported that computer use for two hours a day impairs tear function. The basis of health problems experienced by students is digital eye strain. This situation, which is in parallel with the research, coincides with the findings such as squinting, misreading or approaching the blackboard in students (Gümüş et al., 2009; Yıldırım et al., 2018, p. 134).

In this way, the educational contributions of digital tools can be made continuous and their disadvantages can be minimized. On the other hand, arrangements can be made in the classroom environment, materials and approach principles for students with visual problems. For example, measures can be taken such as placing the student in the front row, putting support friends next to him/her, adjusting the lighting of the classroom, enlarging the font size, vocalizing and presenting it with larger visuals. Digital eye strain has become an issue especially with the increase in interaction with information technologies. Therefore, any unplanned interaction has a great potential to adversely affect eye health. Since it is always better to prevent existing DES cases than to manage it, protective

and preventive measures must be taken such as limiting the time spent in front of the screen, performing routine eye checks, knowing and defining the markers of eye problems, using support materials for dry eye and light intensity, controlling the screen distance, etc. (Sheppard & Wolffsohn, 2018).

Recommendations

Treatment of digital eye-strain syndrome is mandatory with appropriate treatment of systemic diseases that may cause dryness and irritation in the underlying eye. It is necessary to accurately determine the needs of patients with digital eye strain and to apply personalized treatment methods. As a teacher, ensuring that the computer screen is kept at eye level, increasing fluid intake and the number of blinking, eating foods rich in vitamin A, using artificial tear drops, making it a habit to apply the 20/ 20/ 20 rule (zoom for 20 seconds in 20 minutes, and look 20 meters and beyond) and suggestions such as reducing the computer usage time can be developed.

The research is limited to sampling. Training and seminars can be organized within the scope of project with the cooperation of education faculties, the Ministry of Health and the Ministry of National Education. Health problems caused by online learning environments, situations to be considered and precautions to be taken should be included in the content of vocational training. It is recommended that pre-service teachers get information about eye health through pre-service training, plan educational experiences to protect eye health, and take necessary measures to minimize digital eye strain.

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Conflict of Interest

There is no conflict of interest.

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Ethical Standards

All pre-service teachers volunteered for the study.

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