

E-LEARNING: APPROPRIATE E-MATERIALS FORMATTING FOR USERS HEALTH

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***Abstract.** E-learning has a direct relationship with public health as e-materials are making a huge amount of near workload for e-learners' eyes. As it is known, the huge near workload is one of the main reasons for the myopia development of nowadays population. The visual system can quickly become overloaded, especially by inappropriate e-material formatting. Based on theoretical research, incorrect formatting is used in most e-materials based on wrong recommendations. Recommendations and methodologies are not up-to-date for screen use. According to publications in the period of more than 20 years, near work and accommodation are the key factors for myopia development and progression. Appropriate formatting parameters of e-materials play an important role in reducing possible risk factors for myopia development. It could be achieved by using appropriate formatting parameters for e-learners. E-material font type must be perceptible and comprehensible from the screen, font size and line spacing must be appropriate for the reader based at least on its age and intellectual level, colour of background and text must help perception and reading process and could be different for each individual. All variables are important for individual and public health goals. New recommendations and automatization of the formatting process are developed to reach improvement.*

***Keywords:** e-learning, e-materials, e-study, formatting app, myopia, public health.*

Introduction

In the nowadays digital age, mostly everything is connected through digital devices, the Internet, social media, and apps. One smaller or bigger part of an everyday routine or its change same as parameter change of digital devices, programs, and apps, can make an impact on ours or others' life and wellbeing. Especially in the time of fast development and innovation of all life edges.

Public health involves different disciplines as engineering, education, computer science, medicine, sociology, and others (Detels et al., 2009). It is the base of the relationship between them and insight into different factors that affect societies' health, research, develop, and provides innovative solutions.

E-learning as a part of self-development and the modern public educational system has a direct relationship with public health as e-materials that in a different

form are in use of knowledge providing, are making a huge amount of near workload for e-learners' eyes. As it is known, the huge near workload is one of the main reasons for the myopia development of nowadays population. Various types of near work have been suggested to promote the incidence and progression of myopia (Guan et al., 2019). The visual system can quickly become overloaded, especially by inappropriate e-material formatting. Based on theoretical research incorrect formatting is used in most e-materials based on wrong recommendations. Recommendations and methodologies are not up to date for screen use.

According to publications in the period of more than 20 years, near work and accommodation are the key factors for myopia development and progression (Muhamedagic et al., 2014).

Literature review

Despite all the advantages the mobile devices can also create problems such related to losing concentration during classes and diminishing classroom discussion (Maxwell, 2007; Murray, 2011).

Lots of digital device users have a sense of discomfort and vision problems after near work at screens (Kokab & Khan, 2012). It is related to human visual perception (Ramamurthy & Lakshminarayanan, 2015) and how people get and analyzed information. There are differences in perception from printed materials and digital displays (Seok & DaCosta, 2016).

The prevalence of myopia was 18.1% (3607 of 19,934 students). Greater computer use ($P < .001$), smartphone use, television viewing, and after-school study, as well as less midday outdoor time, were also associated with greater myopia prevalence ($P < .001$). Myopia VA $\leq 6/12$ and SE $\leq -0.5D$ in at least one eye (Dirani, Crowston, & Wong, 2018; Guan, et al. 2019).

To successfully participate in e-learning and e-studies, users need both excellent e-skills and well-designed e-learning materials: high-quality content, comfortable, easy-to-understand, and comprehensible text, suitable formatting parameters of e-materials (Mackare, Jansone, & Zigunovs, 2018).

Current research represents a focus on content visualization, such as typographic aspects like font, font size, spacing, and colours. Formatting parameters regulate them. See figure 1. It creates a more individual learning environment that is more comfortable for educational material perception from the screen (Mackare & Jansone 2019b).

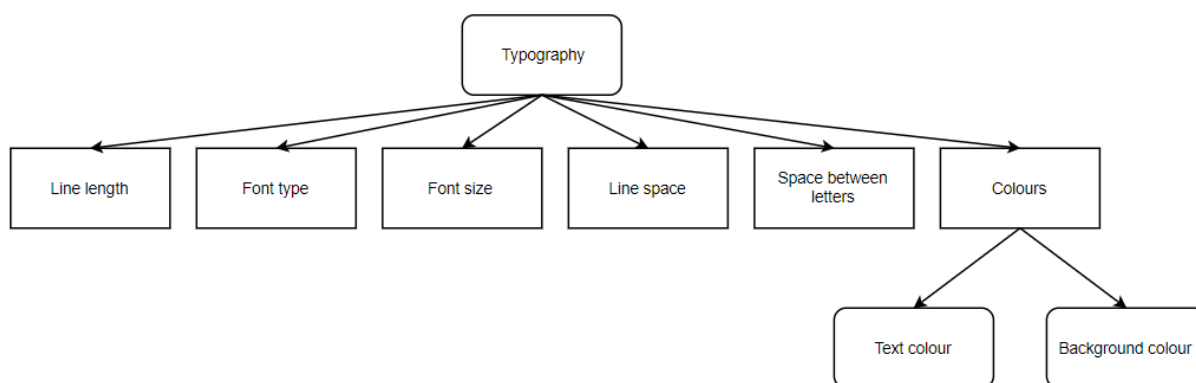


Figure 1 Content visualisation typographic aspects

Recommendations for e-material formatting guidelines (Table 1) of the most important typographic aspects were developed for the target group without reading difficulties and without any significant vision problems. A wider overview has presented at previous publication (Mackare & Jansone, 2017a; Mackare & Jansone, 2017b; Mackare & Jansone, 2018; Mackare, Jansone, & Zigunovs, 2018).

Table 1 Recommendations for guidelines

Target group by age	Formatting parameters				
	Font	Body text size	Headings size	Line spacing	Background and text colour
7-15	Arial	12-18pt	≥14-20pt	1,15	Black on white
	Verdana				Dark grey on white
	TNR				White on black
16 - 39	Arial	≥14pt	≥16pt	1,5	Black on white
	Verdana				Dark grey on white
	Georgia				Dark green on white
40+	Arial	≥14-16pt	≥16-18pt	1,5	Black on white
	Verdana				Dark green on white
	Georgia				Very dark grey on white

Source: Mackare, Jansone, & Zigunovs, 2018

Developed recommendations have been used for automatized e-material formatting app development. The wider overview has presented at previous publications (Mackare, Jansone, & Zigunovs, 2018; Mackare & Jansone, 2019a; Mackare & Jansone, 2019b; Mackare, Jansone, & Konarevs, 2019).

This have been up to date topic for last 20 years but there are not enough research. Is it really formatting change for screen reading to make any improvement in users' comfort or public health?

Methodology

Methodology: Data record examining and short questioner of computer users.

Patient data records

Part 1: Used 879 patient observation record cards of authors-optometrists' patients' data records from 2017 from one of Latvia optic. But there are thoroughly analyzed 867 record cards as 12 were excluded by not full information content. Partly this data has been overviewed in the previous publication (Mackare & Jansone, 2018).

Part 2: Used 1268 patient observation record cards of authors-optometrists' patients' data records from 2018 from one of Norwegian optics.

There are used only on research related data: gender, age, is it first time or repeated check, time between previous and current check, amount of refraction change, is new correction prescribed, is patient computer user, have patient complains about vision and what kind of complains have been found, and objective findings. All data records used according to personal data privacy and security rules.

Questioner contains eight questions – 6 with several answers possibilities as never, sometimes, often or not related, and 2 with yes/no answers. Response collected from 200 respondents-digital device users.

Research results

Patient data analysis:

From 867 record cards of Latvian patients' descriptive statistics shows, 552 patients were women and 315 patients - men, the age group from 12 to 82. Data show, 99,8% of patients use a computer, and 31% of them come for a first vision check.

From 1268 record cards of Norwegian patients' descriptive statistics shows, patients' age group are from 4 to 98. Data show, 100% of patients use a computer and/or other digital devices with screens.

Patient data record analysis:

The most common symptoms and complains of digital device users are combined in Table 2. Data of symptoms and complains mentioned by patients in records represents in percent from Latvia and Norway patients' records.

Almost all patients (99%) mentioned complains about changes in vision (see worse at all distances or only at one), same as 97-98% of patients feel vision clearness change and can't see small letters or numbers at near or long distances. More than half of patients complain about: Problems with changing focus distance, discomfort at near work, reading or computer work, vision becomes

blurry and/or see double and eyes become red. About one half experience symptoms as a feeling of burning, itching, etc. eyes and feeling of dry eyes or feeling of sands in eyes. In most data are no significant differences between Latvian and Norwegian patients except a complaint as the feeling of tiredness in eyes or head.

Table 2 Symptoms mentioned in patients' anamneses

Symptoms/ complains	Symptoms/complains mentioned by patients, %	
	Latvia	Norway
Feeling of dry eyes or feeling of sands in eyes	51	47
Feeling of burning, itching, etc.	52	53
Watery or "running" eyes	21	17
Eyes become red	57	62
pain or pressure-like feeling in eyes	26	23
Headaches (around eyes, in forehead, temples, or back of the head)	31	38
Feeling of tiredness in eyes or head	64	33
Vision become blurry and/or see double	56	59
Feels vision clearness change / can't see small letters or numbers at near or distance	97	98
Problems with changing focus distance	56	68
Changes in vision (see worse at all distances or only at one)	99	99
Discomfort at near work, reading or computer work	59	57
Eyes become sensitive to light	2	3

Patients are not only having complains or symptoms, but there are relevant findings on optometrist vision and eyes examination. The most common optometrist findings of digital device users are combined in Table 3. Data on optometrist findings represent in percent from Latvia and Norway patients' records.

Almost all patients (99%) have changes in visual acuity. Same, about 97-98% of patients, have changes in refraction, and more than half are under myopization process. More than ¾ of patients in Latvia and about 84% of patients in Norway have been diagnosed with a Dry Eye Syndrome by findings of related changes under biomicroscopic observation. Most of this is low or extremely low tear line and conjunctival and/or limbal hyperaemia. In most data is no significant differences between Latvian and Norwegian patients.

Table 3 Findings mentioned in patients' anamneses

Findings	Have changes, %	
	Latvia	Norway
Dry Eye Syndrome related changes by biomicroscopic observation:	75	84
low or extremely low tear line	65	73
foamy tears	9	8
viscous tears	23	21
conjunctival wrinkles	42	37
conjunctival staining	11	9
MGD	25	18
conjunctival and/or limbal hyperaemia	71	69
Conjunctival and limbal hyperaemia without other dry eye syndrome findings	4	6
Accommodation problems	11	13
Changes in visus	99	99
Changes in refraction	98	97
Myopization (Myopia progress, grow)	58	67

Almost all patients (computer users and non-users) had changes in refraction. It varies from $\pm 0,25D$ to $\pm 2,0D$. Internet users till 40 years had average 0,50D (SE=0,013, SD=0,3) change in 6-24 months. Patients over 40 years had bigger change in same period - average 1,0D (SE=0,025, SD=0,47).

Questionnaire data are represented in table 4 and table 5. Data of respondents' answers represents in percent.

Table 4 Patient comfort of reading on screens

Statement	Never	Sometimes	Often	Not related*
Letters and numbers look too small for comfortable reading on computer screen	22%	45%	33%	-
Feel need to adjust reading distance (computer screen)	27%	33%	40%	-
Letters and numbers look too small for comfortable reading on tablet screen	25%	23%	12%	40%
Feel need to adjust reading distance (tablet screen)	23%	11%	26%	40%
Letters and numbers look too small for comfortable reading on smartphone screen	28%	22%	47%	3%
Feel need to adjust reading distance (smartphone screen)	19%	23%	55%	3%

*not related = are not using this kind of device ever or for reading tasks

Questionnaire data represent in table 4 show what 40% of respondents don't have or are not using tablets for reading tasks, same as 3% of respondents don't have or are not using a smartphone for reading tasks. Almost 80% admit that letters and numbers look too small for comfortable reading on a computer screen, and 73% feel a need to adjust the reading distance of a computer screen. More than half of tablet users admit that letters and numbers look too small for comfortable reading, and 2/3 feel a need to adjust the reading distance of the tablet screen. About 70% of smartphone users admit that letters and numbers look too small for comfortable reading, and almost 80% feel a need to adjust the reading distance between eyes and smartphone screens.

Table 5 Need of text increase

Statement	Yes	No
Have you tried to increase a size of letters and numbers you need to read?	49%	51%
Did it help?	80%	20%

Almost half of respondents have tried to increase a size of reading material letters and numbers, and 80% of them experience increase of readability comfort.

Conclusions

Current research and patient data record analysis from Latvia and Norway show screen reading effect on readers vision.

Most digital devices users are experiencing different symptoms and having complains during and after near work, especially related to screen use. A significant part of them are not only having complains, but there have been relevant findings on optometrist vision and eyes examination. A significant part of digital device users has myopization signs based on refraction changes.

Most of the computers, tablets, and smartphone users have experienced what letters and numbers that must be read seems too small and unreadable on screen as well as experienced a need to adjust the reading distance. Almost part has tried to increase a size reading material, and 80% of them experience an increase of readability comfort.

E-material font type must be perceptible and comprehensible from the screen, font size and line spacing must be appropriate for the reader based at least on its age and intellectual level, colour of background and text must help perception and reading process and could be different for each individual.

All variables are important for individual and public health goals. Appropriate formatting parameters of e-materials play an important role in reducing possible risk factors for myopia development.

New recommendations and automatization of the formatting process are in development to reach improvement.

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