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Analysis of students' assessments about the noise educational lecture

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Abstract. Exposure to excessive noise is a major cause of preventable hearing disorders worldwide. Most cases of noise-induced hearing loss are caused by occupational noise exposure. The importance of using hearing protection in the workplace is nowadays well recognized and most industries have programs and regulations in place to ensure the hearing health of their workers. Far less attention has been paid to hearing disorders due to noise during leisure time, although the sound levels of such occasions can exceed occupational safety limits. Moreover, noise induced hearing loss has become one of the biggest health issues among young people's life at the present time. Researchers have noticed that it is mainly caused by being exposed to loud noises during leisure time activities: visiting concerts, nightclubs, sporting events or listening to music with loud devices, such as MP3 players. Average sound level can be between 95…115 dB(A) on such occasions.

The aim of this study was to compose a noise educational lecture for young adults to improve their knowledge about noise and increase their awareness of preventable hearing loss. The noise educational lecture was conducted among students and a feedback questionnaire was handed out to gather students' assessments about the lecture in order to carry out an evaluation process to determine the lecture's effectiveness.

In this article, data about the methodology of the feedback questionnaire and results are presented in order to give an overview of students' opinion about the noise educational lecture and make an evaluation of the lecture.

Keywords: prevention of noise related hearing-loss, education of adolescence, assessment of the educational lecture, the lecture improvement.

Introduction

The impact of the surrounding environment affects human's organism which has to continuously adjust to various factors favourable or unfavourable influence. Among the numerous environmental factors are different kinds of noise exciters (Sergejev, 1974), which are commonly referred to as noise, and play a very important role. Noise is an unpleasant or disturbing sound for a human, or is otherwise hazardous to his physical, mental or social well-being (Heinonen-Guzejev et al., 2010).

Since the 16th century the occupational noise has been investigated worldwide. As a result, legislation has been established as when daily (equivalent to an 8-hour) noise level exceeds 85 dB (A) it is dangerous to the human hearing and health (Estonian Republic Government, 2007). According to the regulation, noise reduction

measures must be used in working environments where noise levels exceed 80 dB (A), in order to ensure employee health and welfare.

Far less attention has been paid to hearing disorders due to noise during leisure time, although it has been found that noise levels in such occasions can be as loud as or even louder than in the case of occupational noise (Jokitulppo, 2009). Over the past 20 years the number of studies on the possible emergence of noise-induced hearing loss among young people has significantly increased, mostly because of today's technology that enables to produce louder sounds. The researches focus on young people's exposure to various noisy activities and the sound pressure levels during such occasions, hazardous noise impact on youth hearing is analysed, and young people's attitudes and behaviours are examined in relations with noise and music. The adolescents' noise exposure in this case is associated with recreational activities and environmental noise. The cause for concern is not only restricted to music from nightclubs and rock concerts, which can be extremely loud, but it extends to the personal music players which can reproduce decibel levels that exceed occupational safety limits. Fligor and Portnuff investigated the loudness produced by the portable digital music players at different volume settings. Averaging the results from different types of earphones, a volume control of 50% produced sound at approximately 70 decibels, of 70% at approximately 80 decibels, and of 100% at approximately 100 decibels. While comparing different head-phones on average, the output level of in-ear headphones was 5.5 decibels higher than over-the-ear headphones (Fligor & Portnuff, 2006). Moreover, the results of the American Speech-Language-Hearing Association research claim that at maximum volume, Apple iPods can produce sound at 120 to 125 decibels, the Sony Walkman MP3 player at 108 to 115 decibels, and the Bratz-Liptunes MP3 player at 115 to 120 decibels (ASHA, 2006). Not only is the noise level the issue, but also the duration and frequency of listening. All this leads to the results that show young adults slight or more serious hearing impairment. The data from two U.S. nationally representative surveys indicates that the prevalence of hearing loss among adolescents increased by about 30 per cent from 1988–1994 to 2005–2006, due to loud sound exposure from listening to music (Curhan et al., 2010). According to the Estonian Association for Hearing Impaired, in recent years hearing loss among young people has been identified far more frequently than before. About 15% of adolescents have a hearing impairment more or less (Sommer-Kalda, 2002).

Noise-induced hearing impairment does not only concern tinnitus, but also the temporary or permanent hearing threshold shift. In addition, noise does not adversely affect only human hearing, but also affects the central nervous system, and through it all human organs and it has been noticed that the noise decreases a person's ability to concentrate and performance.

In order to prevent noise-induced health problems, it is important to increase youth's awareness towards noise hazardousness. Youth's attention should be focused on to the fact that once a hearing impairment has occurred, today's medicine cannot yet restore it. The damage is irreversible. Noise-induced hearing loss and health disorders can be prevented if there is relevant knowledge. Therefore it is important to inform young people in particular, but also parents, teachers and organizers of the consequences of loud noise to the human body and how it can be prevented (reduction of sound pressure levels, use of hearing protection). The potential approach is to carry out a noise educational lecture among young adults, which will introduce problems

concerning excessive noise levels and gives advice on how to reduce the risk of hearing impairment. This research reviews the students' opinion about the conducted noise educational lecture to ensure whether the lecture is suitable or it needs some improvements.

Materials and methods

The research object was the noise educational lecture for students conducted by the author of the article. It is composed based on the Estonian government regulation nr. 108 Occupational Health and Safety Requirements for Noise Affected Working Environment, Noise Limits and Noise Measurement Procedures and the high school syllabus. The lecture has three parts and is supported by a Power Point presentation, which consists of 28 slides. The first chapter gives an overview about sound and its characteristics. The importance of hearing, construction of a human ear and the sound wave transmission is explained in the second chapter. The third chapter concentrates on the noise – what it is and its potential harmful effects to human health. In addition, issues about noise in a living environment are discussed, and especially focused on the noise problem in a young adults' life. The major sources of noise, hazardous noise pressure levels and ways to protect ourselves from noise are also mentioned.

A questionnaire method was used to evaluate relevance and acceptability of the lecture. The purpose of the questionnaire was to get listener's opinions and attitudes towards the content and layout of the lecture, which will help draw conclusions on the informative, novelty and appropriateness of the lecture. A thorough evaluation not only helps to ensure that a lecture is accomplishing its goals, but can also recognise areas that need to be revised or improved. The printed version of the lecture was used as a form, where the participants gave their opinion about the presentation by marking with signs. Four different signs were used: 1) + liked, 2) – did not like, 3)! surprising, interesting, 4)? not clear, confusing. These signs were chosen because they are familiar and common to students. The meanings and the instructions for using signs were explained before the beginning of the lecture in order to avoid misunderstandings afterwards. Students were advised to use the double sign marking if they want to emphasise something on some slides. A combination of two signs was also allowed to be used, for example when the slide was pleasant and also surprising. To reference on a concrete object or statement on the slide, the students were advised to use the circle and an arrow marking. All signs were written to the blackboard before the lecture, so that the students will be able to see them during the lecture and thereby make their assessment easier. Evaluating the lecture was voluntary and anonymous and the audience could fill the questionnaire during the whole lecture. The students' observations were collected, processed and analysed. For processing collected assessments, the Microsoft Office Excel software and an analysis of variance were used.

Before the analysis, slides which do not convey the content of the lecture: title slide, table of contents, a summary and acknowledgements, were left out. Thus, the data file consists of assessments made on 24 lecture slides. In order to describe the data file, the comments on the slides content (physical, human, environment, and their combinations) and format (text, graphics, illustration, video, and various combinations

of these) were included. The slides were divided into different groups according to the slide comment and a variance analysis was made. The single and double signs, except for a question and minus signs, as these marks were made to double comment only once, were added together during the data process. The double sign is greater than the proportion of a single sign, so in case of the double signs assessments the estimation 1.5 coefficient was used.

Results and discussion

102 students from various Tartu county high schools have attended the noise educational lecture since 11.04.2011. The lecture feedback questionnaire was answered by 73% of participants. The reasons why all students did not respond to the questionnaire may be: 1) could not follow the lecture and fill in the questionnaire at the same time; 2) lack of desire to express their views; 3) could not properly understand the explanation of the symbols; 4) the lecture did not appeal.

All in all, students made 1,434 comments on the lecture slides. Most of all (985 marks) students marked plus signs on the slides which means that they liked the presented theme and students had marked that the really enjoyed slides 52 times. An exclamation point, which meant that something is interesting, novel or surprising, was noted in the slides 258 times, the double exclamation mark, which meant that something was very interesting or surprising, was used 27 times. Students had marked 43 times (used one question mark), that something is incomprehensible on some slides, and one case had indicated that something was very unintelligible (used the double question mark). Students had marked the minus signs on the slides on 20 occasions, which meant that they did not like something on some slides and in one case a double minus sign was used to not stress likeability. Different combinations of signs to emphasize and explain the assessment carried out on a slide had been used 44 times. Most of the students had marked both the plus and an exclamation point 33 times, so it can be assumed that the slide was pleasant, interesting and also surprising. On three occasions, the slide was rated with a plus and question mark, which can mean that although the students liked the slide, something was incomprehensible.

In order to carry out the statistical data analysis, the 24 slides of the lecture were stratified according to the content of the slide into the following groups: 1) physics (P) – the physical content of the sound; 2) human (H) – the anatomy of the ear and the harmful effects of noise; 3) physics and environment (P + E) – the physical meaning of noise in the living environment; 4) human and environment (H + E) – effects of the noisy environment on a human. The biggest amount of slides (11) gathered to a group which concerned people. In the physics group, there were five slides, physics and environment and also human-environment related slides group had equally four slides. During the statistical data processing, the average rating for each group was found and the results were compared with each other using ANOVA. As Fig. 1 shows, all groups were mostly assessed with plus signs.

As 74% of the respondents indicated slides with plus signs, it can be assumed that students liked comparatively equally all theme groups in the lecture. There were 44 plus signs on average per slide and a statistically significant difference between groups was not found *($F = 1{,}183$, $p = 0.341$)*. Comparing the results of different groups it can be concluded that slides concerning a human or sound's physical nature in living

environment had the most plus signs. Comparison of groups by exclamation points revealed that the group of slides concerning a human and the environment distinguished from the others by collecting on the average the biggest amount of exclamation marks *(F = 0.534, p = 0.664)*. Therefore it can be concluded that this slide group was the most interesting or most surprising for the students. The slide groups which concerned physics of sound and the physical meaning of noise in an environment gathered the most question marks, so these themes were difficult to comprehend for students. The students did not use many minus signs for assessment and signs were divided equally between the groups *(F = 0.277, p = 0.841)*.

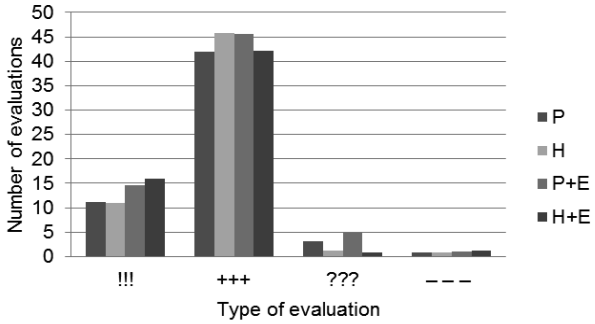

Fig. 1. The distribution of the lecture content based evaluations: P – physics, H – human, P + E – physics and environment, H + E – human and environment.

An analysis of assessments by groups showed that each group includes a slide, which has gathered more evaluations than other slides in side that group as it can be seen from the Fig. 2 below.

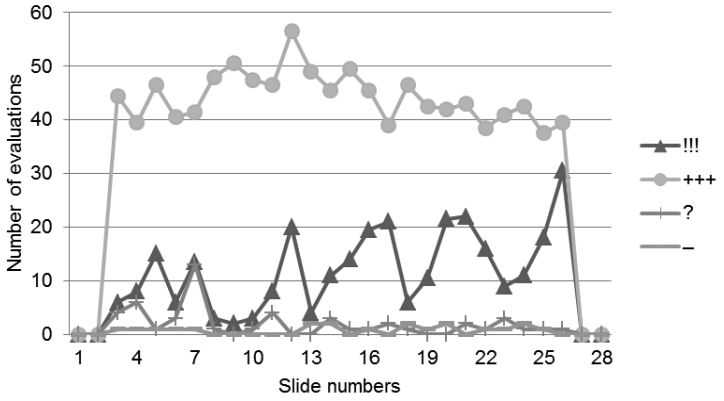

Fig. 2. The overall assessment of the lecture according to slides.

It can be seen from the Fig. 2 that the positive assessments changed considerably during the lecture, showing an upward trend among some slide groups and the most highly rated slides were easy to distinguish. The negative assessments remained relatively the same level among all slides. According to the chart, the most positive

assessment gathered the slide 12, which describes the operation of the hearing and to illustrate this complicated function, a video is shown. From the data it can be calculated that 21% of students think the lecture material is novel, interesting and even surprising for them. The slide number 26, where examples of extreme circumstances concerning noise were displayed and students were given the opportunity to express their own views, was the most interesting for the students. Embracing students to the lecture enlivens listeners and encourages them to think more about this subject. 23% of the students indicated surprising or interesting slides concerned noise-induced hearing loss. This may be due to the fact that students had no previous knowledge that the noise can damage their hearing this way. A small amount of students, 3% of the participants, marked that something in the lecture was incomprehensible. Analysis between slide groups showed that the slides concerning sound physical content raised the most questions among students, therefore the sound physical nature should be explain in more detail during further lectures. Only 1.4% of respondents indicated that some slides in the lecture were unpleasant or uninviting. All in all, by far the largest percentage of estimations, 54% were for slides dealing with the noise concerned with the human: ear anatomy and function, the noise effects on the body and the noise hazardous levels and places the human being was exposed to the noise. Moreover, these slides also had most different combinations of signs.

After the first lecture it was proposed by the students that the lecture should have a summary slide, which brings out the idea of the lecture. This observation was taken into account and the summary slide was attached to the lecture for the next lecture. Although the summary slide was left out from the statistical data processing, it was seen from the data that students accepted the summary slide, as it gathered 42 plus signs and it was marked as interesting and surprising three times. The positive feedback confirmed the necessity of adding the summary slide. More specific proposals have not been done.

Similarly to the lecture slides contents analysis, the lecture slides form/layout analysis was made with ANOVA. In order to do the statistical data analysis, the lecture 24 slides were stratified into the groups according to the layout of the slide. Since in the lecture there were no slides consisting only of graphics or only illustration, their combinations were formed and used for analysis. As only the slide number 12 has video, it was decided to set aside from the data processing. As a consequence, the three following groups were formed: 1) text (T) – only text on the slide; 2) text and graphics (T + G) – both text and graphics on the slide; 3) text and illustration (T + I) – in addition to text also illustrations on the slide. The size of groups was different due to the number of slides: in the text group there were seven slides, text and graphics group had three slides and the most, 13 slides, was the text and illustrations group. According to the Fig. 3, the evaluations given by the students were relatively evenly divided between the different groups.

Likewise for the lecture content evaluation, the students also gave the most plus signs while evaluating the slides layout. As it was assumed, the students assessed more pleasant slides, which besides the text also included the illustrative material, although a statistically significant difference between groups was not found *($F = 1{,}138$; $p = 0.34$)*. Surprising however is that fact that the students found the slides containing only text the most interesting. It is possible to speculate that this is due to the content of the slides. According to the assumption, the students had the most questions about the

slides containing graphics. Students gave the negative assessments far less than the others and as a result, there was no remarkable difference between the groups.

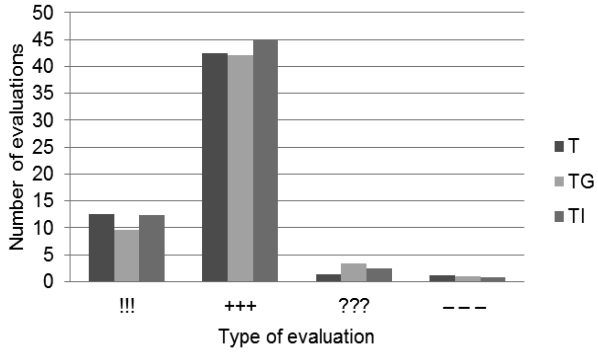

Fig. 3. The distribution of the lecture layout based evaluations: T – text, TG – text and graphics, TI – text and illustrations.

An analysis of assessments inside the groups showed that each group included a slide which has gathered more evaluations than other slides that group. In the text slides group, the highest amount of plus signs gathered was the number eight slide, which explains the necessity of hearing. In the text and graphics group, the slide number five was marked with the most plus signs. That slide explained the nature of the sound frequency and it had graphics for the different frequencies to clarify the subject. In the text and illustrations group the slide number nine, which presented a picture of the external ear, and the slide 15, which explained the different types of noise and an image of the source that generates the noise was displayed, collected equally the most plus signs. As mentioned above, the students evaluated the most interesting and surprising slides containing only text. The reason was the slide 26, which gave students the facts about the noise in extreme situations. There were six different facts on the slide and in half of the cases the numerical values were covered. These values were presented after the students had been asked and given their opinion about the fact. This kind of action enlivens the audience and it is possible to speculate that the students could understand and memorise the subject through this action more successfully. The slide number five with sound frequency graphics was evaluated as the most surprising and interesting by students. The most interesting slides among the text and illustrations group was slides, which represented different sound pressure levels in a living environment with examples and the effect of the noise on hearing (e.g. hair cells fatigue). According to the question mark analysis, slides containing text and graphics were the most difficult to comprehend by students. The slide, which explained and had the graphics describing the amplitude of the sound, was evaluated with the most question marks. The equation also used to describe the connection between sound pressure and sound pressure level remained unclear. In subsequent lecture sessions, more time should be planned to discuss and explain the confusion caused issues, and it is also important to look for better ways to explain these topics to students (using illustrative objects, animation, real-life examples, etc.).

It can be concluded that the layout of the lecture slides is generally constructed correctly and acceptably, as the students gave mostly positive evaluations for the slides. Using slides which in addition to the text had also illustration or animation was a justified choice, because slides using one or both of these options were evaluated highly and this may be due to the fact that they were easy and interesting to follow and students did not became bored. While presenting only text slides, students should be asked questions or their opinion about the subject, because as the analysis showed, students liked participating in the lecture.

Conclusions

As the results of this research show, the educational lecture is acceptable by students as long as it is composed bearing in mind that it is directed to young adults. It means that the more illustrative materials, animations, videos and students involvement in the lecture is used, the better they understand the subject. In order to make the noise educational lecture more efficient, the sound and noise physical nature should be explained more clearly, as this topic was the most difficult for students to understand. As the lecture was successful, it is advisable to continue its presentation in high schools. Estonian University of Life Sciences ergonomics specialty post-graduates are probably the most suitable to arrange the noise educational lecture or analogous lectures for students as they have the appropriate knowledge and experiences related to that. For future research, it is advised to carry out a questionnaire about the noise before and after the lecture to see whether they participants have improved their knowledge and behaviour towards noise.

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