HEDforALL: Holistic Approach to Accessible Higher Education

D4.1 Evaluation of educational materials by Students with Disabilities

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Abbreviations

Acronym	Term
HE	Higher education
HEI	Higher education institution
ICT	Information and Communications Technology
HEDforALL	HOLISTIC APPROACH TO ACCESSIBLE HIGHER EDUCATION
SwD	Students with Disabilities
UOM	University of Macedonia
CNR-ITD	National Research Council of Italy – Institute for Educational Technology
UA	Universidad de Alicante
VI	Visual Impairment
HE	Hearing Impairment
MI	Mobility Impairment
LD	Learning Difficulty/ies
MS Word	Microsoft Word

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About HEDforALL

The aim of the project is to develop a set of educational material development practices and DE/e-Learning methodologies for the implementation of digital education in higher education. Teaching SwD in higher education presents unique challenges for SwD and their educators, caused by the lack of accessible digital resources based on the type of disability (visual, hearing, mobility/physical impairments and learning difficulties). Teaching staff and accessibility advisors often don't know how to support SwD. The concrete aims of the project are to: a) improve the inclusion of Students with Disabilities (SwD) (i.e. visual, hearing, mobility impairments and learning difficulties) in Higher Education Institutes (HEIs) and support academic personnel to develop digital competences in order to cope with the SwD's needs on accessible resources and the shift to e-learning, b) expand provision for all SwD studying in higher education by raising awareness of the whole academic community on their needs, c) address and tackle intersecting drivers of learning disadvantage, exclusion and drop out by hearing the voices of the actual SwD, traditionally excluded or silenced, and d) increase awareness on the type of support SwD expect to receive during learning and teaching practices in HEIs, regarding accessible educational resources and DE, in order to build a more inclusive higher education ecosystem.

The overall objectives of the project are to:

- **Enhance Educational Accessibility for Students with Disabilities (SwD):** To improve the availability and quality of accessible educational materials and distance education (DE) practices in higher education, ensuring that SwD have equitable access to educational opportunities across various subjects and courses.
- **Strengthen Professional Competence and Awareness:** To build the capacity of higher education teaching staff and accessibility advisors by enhancing their knowledge, skills, and practices in creating and implementing accessible educational materials and DE methods, thereby fostering an inclusive learning environment for SwD.
- **Develop and Implement Effective Accessible Resources:** To design, produce, and evaluate high-quality, accessible educational materials that meet the specific needs of SwD, ensuring these resources are effective in terms of accessibility, usability, and educational impact.
- **Promote Inclusive Distance Education Practices:** To integrate inclusive DE strategies and resources into higher education curricula, enabling institutions to effectively support SwD in both traditional and online learning environments.

The specific objectives of the project are:

- To identify the needs and requirements of SwD for accessible materials regarding different subjects/courses taught in higher education and the needs revealed by distance education to SwD themselves.
- To examine existing knowledge and experience of higher education teaching staff and accessibility advisors in relation to various forms of accessible materials and distance education practices for SwD in order to/and determine their training needs; to examine the impact of the training on their knowledge.

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- To build capacity and professional development for teaching staff and accessibility advisors that will enable them to develop accessible educational materials and DE methods for inclusive DE classes in order to provide SwD with meaningful, high-quality educational opportunities
- To develop the most suitable accessible educational materials for SwD in terms of accessibility, usability and educational efficacy and evaluate it indepth through studies with end-users.
- To develop training material for teaching staff and accessibility advisors (e.g. Accessible Material Guide, Educational YouTube videos, and Guide for DE programs), with a concrete set of practices and guidelines for accessible educational material production as well as for the implementation of DE programs to SwD.
- To implement pilot accessible DE courses with SwD, and evaluate its accessibility adequacy and learning results.
- To implement the first open and free online repository of accessible educational material of different subjects to be used by educators and any interested party.
- To share project results at international level.

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1.1. Study of Individuals with Visual Impairments

1.1.1. Participants

Eleven higher education students with visual impairment participated in the study, Participant 1 (P1) – Participant 11 (P11). Five participants were men and six were women. The average age of the participants was 25 years old. Seven of the participants came from Greece and four came from Spain. Seven participants were undergraduates and four were post-graduates persuing a Master's degree. Six participants were students of the University of Macedonia, four were students of the University of Alicante and one was a student of the Aristotle University of Thessaloniki. Three participants were students in the Department of Educational and Social Policy, two in Social Sciences, two in the Department of Music Sciences and Art, one in the Department of Physics, one in Law and International Relations, one in Economics and one in Applied Informatics.

Among the participants, five had congenital visual impairment, while the other six obtained visual impairments during their early childhood, from 2 months old to 8 years old. Concerning the severity of the impairment, five participants were blind, three had severe visual impairment, and three had low vision. Regarding their clinical diagnosis, four participants reported congenital etiology, two participants reported Leber Hereditary Optic Neuropathy, one reported Stargardt disease, one reported a medical mistake, one reported Peters anomaly, one mentioned optical nerve atrophy due to accident and one reported retinitis pigmentosa. Concerning the visual acuity of the left eye, three participants mentioned no light perception, three less than 1/20, two total blindness / loss of light perception and two better than 1/20 and worse than 1/10, while one was not able to answer. Concerning the visual acuity of the right eye, three participants mentioned total blindness / loss of light perception, three no light perception, two less than 1/20 and two better than 1/10, while one was not able to answer. Regarding their visual field, four participants reported a full visual field, one reported central vision loss, one mentioned peripheral vision loss and five participants were not able to give an answer. Six out of the 11 participants knew braille or used a screen reader, three used large prints or a magnifier and two used all of the above. It must be noted that one participant that had low vision knew how to read Braille, while one participant with blindness did not and that is reflected on the experiments they participated in.

Lastly, regarding their mobility, seven participants reported moving alone, three reported sometimes alone and sometimes with the help of an attendant and one reported moving with the help of an attendant. As for the frequency in which they move alone, four mentioned moving alone always, four most of the time, two some times and one never.

1.1.2. Instruments

The tools used for the present study are as follows: a) questionnaire for collecting demographic information of the participants, b) scenarios of activities for navigating accessible educational material with additional comprehension questions on specific material - i.e., on images and video., c) semi-structured interviews for evaluating the accessible educational material, and d) questionnaire on the usability of the accessible educational material.

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1.1.3. Procedure

The process of the experiment consists of a set of structured steps for collecting data and evaluating the accessible educational material. The use of multiple tools such as the semi-structured interview and the usability questionnaire can provide further information on how users interact with the accessible educational material and how useful they consider it to be. The steps were as follows:

- Step 1. Participants answered the demographic questionnaire.
- Step 2. The scenario was implemented for each accessible educational material and comprehension questions were added where needed (e.g. images, videos).
- Step 3. Participants independently explored the accessible educational material following a think aloud protocol.
- Step 4. The semi-structured interview was conducted.
- Step 5. The usability questionnaire was completed.

It must be noted that the accessible materials for images (verbal description, prints on microcapsule paper, tiger embossed prints and audio-tactile images) were presented in a randomized order to the participants in order to deal with order effects.

1.1.4. Analysis

During the assessment of accessible educational material, the following variables were used to measure the effectiveness of the educational material in achieving the desired learning outcomes.

- Success/Unsuccess: This variable indicates whether the participant was successful or unsuccessful in completing the scenario.
- With/without help: This variable indicates whether the participant completed the scenario with or without assistance.
- Time: This variable measures the time taken by the participant to complete the scenario.
- Interruption for solution by himself, by help: This variable measures the number of times the participant was interrupted and needed help to find a solution to complete the scenario.
- Times of interruption: This variable measures the total number of interruptions experienced by the participant during the completion of the scenario.

By collecting and analyzing these variables, researchers and educators can identify areas where participants may be struggling or where the educational material needs improvement to better support learning outcomes.

1.1.5. Results

The results for each accessible educational material are presented. The accessible educational material included the MS Word textbook, which was a book without (complex) images and tables. The same book was also examined in three other formats (DAISY-Textbook, PDF-textbook and Epub-Textbook). In order to compare the four formats, participants performed the same tasks in each format (word, DAISY, PDF ePub). The next accessible educational material was examined, which was the Word-Samplebook. This book covered all possible cases of charts and tables. The same book was

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also examined in three other formats (DAISY-Samplebook, PDF-textbook and Epub-Samplebook). In order to compare the four formats, participants performed the same tasks in each format (word, DAISY, PDF, ePub). Other accessible educational materials were a ppt presentation, verbal descriptions of images, tactile images in piaf and tiger formats, audio-tactile images, mathematical and chemical equations with verbal descriptions and / or produced with MathType and an accessible video for people with visual impairments.

Participants 8-11 did not complete the DAISY tasks for the simple textbook and partcipants 7-11 did not complete the DAISY tasks for the complex textbook, so there are no available data for them. Participants 2 and 7 did not complete the tasks with tactile materials (microcapsule and tiger embossed prints) as both did not know Braille and were exempt from these tasks. As a result, there are no available data for them in these tasks. There are also no available data for P8-P11 as they did not complete the tasks for the tiger embossed prints.

Participant 2 answered only to the comprehension questions for one of the audio-tactile images according to the protocol for low vision participants. There are also no available data for P8-P11.

MS Word – Textbook

Scenarios

Tables 1-2 present the results of an assessment of eleven participants' completion of a task involving a Word textbook.

Table 1 shows that all participants were successful in completing the task "Find chapter 4 ‘Responsibility and Choice ‘". Seven of the participants completed the task without any help, while four participants needed help once. The average completion time was 100 seconds. Most participants who needed help had to interrupt themselves or ask for help twice during the task, while participants who completed the task without help interrupted themselves or asked for help once or not at all.

Participants	Success/Unsuccess	With/Without help	Time (sec)	Interruption for solution by himself, by help	Times of interruption
P1	S	without	15	himself	1
P2	S	with	133	help	2
P3	S	without	24		0
P4	S	with	176	both	2
P5	S	without	72	herself	1

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P6	S	with	75	help	2
P7	S	without	222		0
P8	S	without	34	himself	1
P9	S	with	35	himself	0
P10	S	without	40	help	0
P11	S	without	275	himself	0

Table 1. First task from MS Word - Textbook

Table 2 displays that all participants were successful in completing the task “Go to page 16”. The average completion time was 55 seconds and most participants completed the task without help. Six participants had an interruption once as they needed a nudge to complete the task. Overall, the results suggest that the task was relatively easy for the participants.

Participants	Success/Unsuccess	With/Without help	Time (sec)	Interruption for solution by himself, by help	Times of interruption
P1	S	without	18	both	1
P2	S	without	110		0
P3	S	with	51	help	1
P4	S	with	73	both	1
P5	S	without	106	help	1
P6	S	with	58	help	1
P7	S	without	10		0
P8	S	without	30	help	1
P9	S	without	11	help	0
P10	S	without	24	himself	0
P11	S	without	116	help	1

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Table 2. Second task from MS Word Textbook

Independent exploration

From the statements given during the independent exploration, the following themes can be identified for the participants' opinions on the accessible educational material (MS Word – Textbook):

- **Navigation**: Participants find the document navigation features helpful, such as the availability of shortcuts (H) for headings and the table of contents. However, some emphasized the importance of already having ICT skills to be able to explore a document.
- **Usability issues**: Most participants mentioned preferring text in Word format and emphasized its familiarity, two specifically compared it with the PDF format and found the Word superior. However, one participant found the synthetic voice monotonous.

Semi-structured interview

The semi-structured interview consisted of 5 questions, which are listed below along with the participants' answers.

1. We would like you to make a general comment on the material. How do you evaluate it (positive / negative)?

- All of the participants had positive evaluations of the material when asked to provide a general comment.

2. What would you keep and what would you change about it? How (in which way) would you change each item you suggest for a change? Can you suggest some changes and improvements

- All of the participants reported that they would not change a thing in the book presented during the task.
- Only one out of the 11 participants made a suggestion on **navigation**. The participant suggested dividing the book in separate Word files, each for a chapter, to make navigation faster as they would have to explore a shorter file each time.

3. Could you obtain the information/ knowledge provided by this material in another way? e.g., using some or a combination of some other alternative forms of educational material? What are they? (Should be listed individually or in combination).

- **Alternative formats**: Participants showed a preference for Word, but they mentioned alternative formats such as PDF, HTML, Daisy, Epub and even printed formats such as braille books, when asked. One participant also suggested Rich Text Format (RTF).
- **Audio-book version**: Three participants suggested an audio-book version.

4. Where do you think this material would be helpful for you during your university studies (in which tasks / activities)?

- Academic tasks, mainly projects and essays
- Exams
- Lecture notes
- Studying

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Based on the answers given by the participants, it seems that the material provided would be useful for various tasks and activities during their university studies. A few participants even commented that the material would be helpful everywhere, as in all tasks.

5. What are the advantages and disadvantages of this form of material?

Advantages

- Headings.
- Full access to information.
- Table of contents.
- Popular / Widely available.
- Ability to use everywhere.
- Familiarity.
- User-friendliness.
- All content is readable.

Disadvantages

- Difficulty in finding paragraph boundaries.
- Information about the text can be overwhelming.
- Navigating only with arrows could take too much time in some cases.
- Monotonous robotic voice from the screen reader (NVDA).

Overall, it seems that the advantages of using Word documents for reading and navigation outweigh the disadvantages, but it is important to consider individual preferences and needs when selecting a format for reading and accessing information. Most participants commented on the advantages of Word documents as they are familiar to them and easily available. The disadvantages mentioned were each mentioned once by one of the participants underlying the importance and variety of individual preferences.

Usability Questionnaire

A usability questionnaire used to gather feedback from users regarding the accessibility, usability, and effectiveness of the material. The questionnaire aims to identify any potential issues or barriers that users may encounter when accessing or using the material. The feedback collected can then be used to improve the design and accessibility of the educational material, making it more effective and user-friendly for individuals with visual impairments. Additionally, the questionnaire can help ensure that the educational material meets accessibility standards and guidelines.

The questionnaire contained the following questions, for which the participants' answers are reported, and their interpretation is given.

1. How accessible is the material? - The respondents rated the accessibility of the material with an average score of 9.6 as the majority rated the material with 10. This suggests that the material is easy to access.
2. How difficult was it for you to use it? Most respondents had no difficulty with scores ranging from 1 to 2, with only one participant giving a score of 5. The average score was 1.54 indicating that the material is very easy to use.
3. To what extent is training required to be able to use it? - The scores for the amount of training required to use the material varied had an average of 5. Respondents indicated that some level of training is necessary to become familiar with the navigation options.

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4. Would you use it if it was available to you? All respondents gave a score of 10, unanimously showing they would use the material if it were availale.
5. Would you recommend others to use it? - The respondents indicated that they would recommend others to use the material, with an average score of 9.7 and most giving a score of 10.
6. To what extent do you believe it will fill gaps of your existent knowledge? – The majority of participants gave a score of 10 while one gave a score of 8, with an average score of 9.8.
7. Could you obtain the information/ knowledge provided by this material in another way? - The respondents were divided in their responses to this question, with some indicating that they could obtain the information through other means, mainly audio while others indicated that the material provided important advantages. The average score was 5.9.However, it must be noted that this question seemed to confuse the participants.
8. Do you think that the material successfully meets the purpose for which it was built? - Respondents generally believed that the material successfully meets the purpose for which it was built, with an average score of 9.5.
9. How useful would this material be for your university studies? - The respondents rated the usefulness of the material for their university studies, with an average score of 9.9. This suggests that the material would be very useful for their studies.
10. How tedious is the material? The respondents rated the material as not very tedious, with an average score of 1.7.
11. How complex and complicated is the material? - The respondents rated the complexity and complication of the material, with an average score of 2.2. This suggests that the material is not very complex or complicated.
12. How much load (memory and attention) does the material's use require? - The scores for the amount of memory and attention required to use the material varied, with an average score of 4.8. This suggests that the material requires some level of attention and memory.
13. How satisfied are you with the use of this material? - The respondents rated their satisfaction with the use of the material, with an average score of 9.

PDF – Textbook

Scenarios

Tables 3-4 present the results of an assessment of eleven participants' completion of a task involving a PDF textbook.

Table 3 shows that the majority participants were successful in completing the task "Find chapter 4 'Responsibility and Choice '". Six of the participants completed the task without any help, while five participants needed help. The average completion time was 92.6 seconds. Most participants who made an interruption themselves during the task, while some participants needed ta make an interruption before completing the task themselves.

Participants	Success/Unsuccess	With/Without help	Time (sec)	Interruption for solution by himself,	Times of interruption

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				by help	
P1	S	with	55	both	2
P2	S	with	185	both	3
P3	U	with	254		1
P4	S	without	46		0
P5	S	with	122	help	1
P6	S	without	44		0
P7	U	with	216		1
P8	S	with	2	both	2
P9	S	without	28	himself	1
P10	S	without	32	himself	0
P11	S	without	35	help	1

Table 3. First task from the PDF - Textbook

Table 4 displays that all participants were successful in completing the task “Go to page 16”. The average completion time was 75 seconds and most participants completed the task without help. Most participants made an interruption by themselves and then continued on with the task. Overall, the results suggest that the task was relatively easy for the participants.

Participants	Success/Unsuccess	With/Without help	Time (sec)	Interruption for solution by himself, by help	Times of interruption
P1	S	without	5		0
P2	S	with	221	herself	3
P3	S	without	81		0
P4	S	without	18		0
P5	S	without	22		0
P6	S	with	92	help	1

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P7	S	without	145	help	1
P8	S	without	10	himself	1
P9	S	without	17	himself	1
P10	S	without	196	himself	1
P11	S	without	21	himself	1

Table 4. Second task for the PDF Textbook

Independent exploration

The statements given during the independent exploration were quite positive. Participants said they wished the PDF files they came across were as accessible and easy to navigate as the one presented in the study. It must be noted that participants showed a negative attitude towards the PDF format before exploring the textbook created for the experiments. After exploring this material, they usually commented on how easy it was to use and how rare it is to find accessible PDF files. One participant also mentioned the importance of personal preference in the textbook format each student uses.

Semi-structured interview

The semi-structured interview consisted of 5 questions, which are listed below along with the participants' answers.

1. We would like you to make a general comment on the material. How do you evaluate it (positive / negative)?

- The majority of the participants had positive evaluations of the material when asked to provide a general comment. Only two underlined that the PDF files they have available are not so easy to navigate.

2. What would you keep and what would you change about it? How (in which way) would you change each item you suggest for a change? Can you suggest some changes and improvements

- Some participants commented they would not change anything.
- Some participants made suggestions on **navigation**. Participants would change the navigation options, such as the navigation for pages. One participant would like an introductory paragraph in the textbook to inform them about the best options and shortkeys for navigation.
- One participant commented that words in capital were not read clearly by the screen reader (NVDA).

3. Could you obtain the information/ knowledge provided by this material in another way? e.g., using some or a combination of some other alternative forms of educational material? What are they? (Should be listed individually or in combination).

- **Alternative formats**: Participants showed a preference for Word, but they mentioned alternative formats such as PDF, HTML, Daisy, Epub and even printed formats such as braille books, when asked. One participant also suggested Rich Text Format (RTF).

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- **Audio-book version**: Two participants suggested an audio-book version.

4. Where do you think this material would be helpful for you during your university studies (in which tasks / activities)?

- Academic tasks, mainly projects and essays
- Exams
- Lecture notes
- Studying

Based on the answers given by the participants, it seems that the material provided would be useful for various tasks and activities during their university studies. Two participants even commented that the material would be helpful everywhere, as in any task.

5. What are the advantages and disadvantages of this form of material?

Advantages

- Full access to text / information.
- Accessible images.
- Table of contents.
- Easy navigation with shortkeys.
- Popular text format during university studies.

Disadvantages

- Difficulty in finding paragraph boundaries.
- Navigating only with arrows is time consuming.
- Difficult to use.
- Some words written in capital letters are not properly read by the robotic voice from the screen reader (NVDA).

Overall, it seems that the PDF textbook was positively received by the participants even if they had negative experiences with this format in the past. Most participants recognised it was easy to use with a little of practice and recognised that it is a widely used text format in higher education.

Usability Questionnaire

A usability questionnaire used to gather feedback from users regarding the accessibility, usability, and effectiveness of the material. The questionnaire aims to identify any potential issues or barriers that users may encounter when accessing or using the material. The feedback collected can then be used to improve the design and accessibility of the educational material, making it more effective and user-friendly for individuals with visual impairments. Additionally, the questionnaire can help ensure that the educational material meets accessibility standards and guidelines.

The questionnaire contained the following questions, for which the participants' answers are reported, and their interpretation is given.

1. How accessible is the material? - The respondents rated the accessibility of the material with an average score of 8.9. This suggests that the material was easy to access.
2. How difficult was it for you to use it? The respondents rated the adifficulty of the material with an average score of 2.2 indicating that the material was quite easy to use.
3. To what extent is training required to be able to use it? - The scores for the amount of training required to use the material varied had an average of 4.9. Respondents indicated that some level of training is necessary to become familiar with the navigation options.

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4. Would you use it if it was available to you? Respondents gave an avarage score of 8.3 showing they would likely use the material.
5. Would you recommend others to use it? - The respondents indicated that they would recommend others to use the material with an average score of 8.7.
6. To what extent do you believe it will fill gaps of your existent knowledge? – The participants gave an average score of 9.2 with seven of them giving a score of 10.
7. Could you obtain the information/ knowledge provided by this material in another way? - The respondents were divided in their responses with an average score of 6.5 showing a slight preference towards other text formats.
8. Do you think that the material successfully meets the purpose for which it was built? - Respondents generally believed that the material successfully meets the purpose for which it was built, with an average score of 8.8.
9. How useful would this material be for your university studies? - The respondents rated the usefulness of the material for their university studies with an average score of 9. Six responed gave a score of 10. This suggests that the material would be very useful for their studies.
10. How tedious is the material? The respondents rated the material as not very tedious, with an average score of 2.8. However, the score varied greatly with a range from 1 to 9.
11. How complex and complicated is the material? - The respondents rated the complexity and complication of the material, with an average score of 2.9. This suggests that the material is not very complex or complicated.
12. How much load (memory and attention) does the material's use require? - The scores for the amount of memory and attention required to use the material varied, with an average score of 4.5. This suggests that the material requires some level of attention and memory.
13. How satisfied are you with the use of this material? - The respondents rated their satisfaction with the use of the material, with an average score of 8.9.

DAISY – Textbook

Scenarios

Tables 5-6 represent the results of an assessment of participants' completion of tasks involving a DAISY textbook. Participants 8-11 did not complete the task, so there are no results recorded for them.

Table 5 shows that the majority of the participants who completed the task "Find chapter 4 'Responsibility and Choice '" were successful. All participants needed help to complete the task with three participants interrupting themselves during the task. Three participants had no interruptions, while two particiapants had three interruptions each during the task. The average completion time was 145 seconds.

Participants	Success/Unsuccess	With/Without help	Time (sec)	Interruption for solution by himself, by help	Times of interruption
P1	S	with	135	both	3

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P2	S	with	384	help	3
P3	S	with	168	help	2
P4	U	with	180		0
P5	S	with	18		0
P6	S	with	10	help	1
P7	S	with	123		0

Table 5. First task from DAISY- Textbook

Table 6 displays that the majority of participants were successful in completing the task "Go to page 16". Five participants needed help to complete the task, while two did not. The average completion time was 140 seconds. Most participants had at least one interruption during the task by help.

Participants	Success/Unsuccess	With/Without help	Time (sec)	Interruption for solution by himself, by help	Times of interruption
P1	U	with	131	himself	2
P2	S	with	217	help	3
P3	S	with	173	help	1
P4	S	without	127		
P5	S	without	125	help	2
P6	S	with	127	help	1
P7	S	with	82	help	1

Table 6. Second task from DAISY Textbook

Independent exploration

Overall, participants expressed that the DAISY format was not familiar to them so they found it difficult to navigate or had issues with certain aspects such as page numbering. Some even noted that they would only use it if no other text form was available. Only one participant expressed a positive opinion by saying she liked it.

Semi-structured interview

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The semi-structured interview consisted of 5 questions, which are listed below along with the participants' answers.

1. We would like you to make a general comment on the material. How do you evaluate it (positive / negative)?

- Four participants gave a positive evaluation of the material. One participant was ambivalent and two noted that it was complex and unnecessary compared to other text formats.

2. What would you keep and what would you change about it? How (in which way) would you change each item you suggest for a change? Can you suggest some changes and improvements?

- The majority of participants reported they would not change anything mainly because they could not think of a way to improve it. Two participants would change the **navigation** in order to exchange the shortkeys of DAISY for shortkeys that are more familiar to them and work with other text formats as well.

3. Could you obtain the information/ knowledge provided by this material in another way? e.g., using some or a combination of some other alternative forms of educational material? What are they? (Should be listed individually or in combination).

- The majority of participants prefer the format of Microsoft Word. Participants also mentioned other text formats such as PDF, ePUB, audiobooks, printed books in Braille, recorded audio material in mp3 format, RTF text and two participants even mentioned Microsoft PowerPoint. One participant also mentioned the internet as a source and means to read textual information.

4. Where do you think this material would be helpful for you during your university studies (in which tasks / activities)?

- Academic tasks
- Studying
- Academic projects and essays
- Lecture notes

The participants found a variety of uses for the DAISY text format. However, one participant still underlined their preference for other text formats by mentioning they would use them only if a DAISY text was the only available format.

5. What are the advantages and disadvantages of this form of material?

Based on the responses of the participants, the advantages and disadvantages of this form of material are as follows:

Advantages:

- Access to text information.
- Navigation options (similar to Word).

Disadvantages:

- Not user friendly.
- Lags behind in speed.
- Complex navigation options.
- Unfamiliar format (a matter of habit / quite rare to find).

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It is important to mention that one participant found the navigation easy, while another found it complex. Overall, it can be concluded that the form of material has both advantages and disadvantages depending on the user's preferences, needs and ICT skills.

Usability Questionnaire

The questionnaire contained the following questions, for which the participants' answers are reported, and their interpretation is given.

1. How accessible is the material? - The average response is 8.2 out of 10, indicating that the participants found the material to be generally accessible.
2. How difficult was it for you to use it? - The average response is 3.4 out of 10, indicating that the participants did not find the material very difficult to use.
3. To what extent is training required to be able to use it? - The average response is 5.2 out of 10, indicating that the participants believed that some training may be required to use the material effectively.
4. Would you use it if it was available to you? - The average response is 7.2 out of 10, indicating that the participants would likely use the material if it were available to them.
5. Would you recommend others to use it? - The average response is 7.8 out of 10, indicating that the participants would likely recommend the material to others.
6. To what extent do you believe it will fill gaps of your existent knowledge? - The average response is 8.2 out of 10, indicating that the participants believe the material would fill quite a few gaps in their knowledge.
7. Could you obtain the information/ knowledge provided by this material in another way? - The average response is 6.7 out of 10, indicating that the participants believed that there are other ways to obtain the information/knowledge provided by the material but are divided on which is more effective.
8. Do you think that the material successfully meets the purpose for which it was built? - The average response is 8.1 out of 10, indicating that the participants believed that the material successfully meets its purpose.
9. How useful would this material be for your university studies? - The average score was 7.8 out of 10, indicating that the participants found the material to be fairly useful for their university studies.
10. How tedious is the material? - The average response is 5.1 out of 10, indicating that the participants were divided in how tedious the material is.
11. How complex and complicated is the material? - The average response is 5 out of 10, indicating that the participants were divided in how complex or complicated the material is.
12. How much load (memory and attention) does the material's use require? - The average response is 6.7 out of 10, indicating that the participants believed that the material's use requires some memory and attention load.
13. How satisfied are you with the use of this material? - The average response is 7.2 out of 10, indicating that the participants were somewhat satisfied with the use of the material.

ePub – Textbook

Scenarios

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The results of an evaluation of eleven participants' performance on a task involving an ePub textbook are presented in Tables 7-8.

Table 7 shows that ten out of 11 participants were successful in completing the task "Find chapter 4 ‘Responsibility and Choice ‘". The average completion time was 100 seconds. Seven participants completed the task with help and four completed without. Most participants has at least one interruption, seven by help and three by themselves.

Participants	Success/Unsuccess	With/Without help	Time (sec)	Interruption for solution by himself, by help	Times of interruption
P1	S	with	147	help	2
P2	S	with	113	help	3
P3	S	with	202	help	2
P4	S	with	76	help	2
P5	S	with	71	herself	1
P6	U	with	300	help	3
P7	S	without	25		0
P8	S	with	4	help	2
P9	S	without	4	help	1
P10	S	without	134	himself	1
P11	S	without	30	himself	0

Table 7. First task from ePub-Textbook

Table 8 displays that ten out of 11 participants were successful in completing the task “Go to page 16”. The average completion time was 165 seconds. The majority of the particiapants had an interruption by help during the task and five participants had multiple interruptions, while two participants completed without any interruptions.

Participants	Success/Unsuccess	With/Without help	Time (sec)	Interruption for solution by himself, by help	Times of interruption

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ΙΔΡΥΜΑ ΚΡΑΤΙΚΩΝ ΥΠΟΤΡΟΦΙΩΝ IKY

P1	S	with	110	help	1
P2	S	with	416	help	5
P3	U	without	224	help	3
P4	S	with	198	help	3
P5	S	with	219	help	3
P6	S	without	132		0
P7	S	without	155		0
P8	S	with	58	help	1
P9	S	without	90	help	1
P10	S	without	193	himself	1
P11	S	with	29	help	2

Table 8. Second task from ePub-Textbook

Independent exploration

During the independent exploration of the ePub textbook, most participants did not make additional comments while two mentioned that it was unfamiliar to them and that they had not received any prior training on this text format.

Semi-structured interview

The semi-structured interview consisted of 6 questions, which are listed below along with the participants' answers.

1. We would like you to make a general comment on the material. How do you evaluate it (positive / negative)?

- Five participants rated the material positively, four rated it negatively, one moderately and one did not give an answer. One participant who rated the material positively, also noted that it was difficult and another noted that he would prefer using it on an iPad instead of a PC.

2. What would you keep and what would you change about it? How (in which way) would you change each item you suggest for a change? Can you suggest some changes and improvements?

- **Navigation**: Most participants made comments on navigation options. One would keep the interactive index, while another would change it. One participant would make the shortkeys much these of Microsoft Word and another would keep the possibilities given by the arrow keys but would change the fact that the NVDA shortkeys interrupted the synthetic voice of Thorium Reader.

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3. Could you obtain the information/ knowledge provided by this material in another way? e.g., using some or a combination of some other alternative forms of educational material? What are they? (Should be listed individually or in combination).

- Participants mentioned other text formats such as PDF, ePUB, audiobooks, printed books in Braille, books in large print, recorded audio material in mp3 format. One participant mentioned html content as an option and RTF and another mentioned Microsoft PowerPoint. Overall, the majority of respondents mentioned Microsoft Word and one participant mentioned only Braille books. It is worth noting that one participant mentioned they would convert the content into Word as they consider ePUB and PDF problematic text forms.

4. Where do you think this material would be helpful for you during your university studies (in which tasks / activities)?

- Academic tasks
- Reading
- Exams
- Lecture notes

The participants mentioned different ways in which the material could be helpful during their university studies. However, one mentioned they would not use this text format and would prefer others during their studies in ordet to have access to academic books and another underlined that it would be useful for these tasks in theory, not practice.

5. What are the advantages and disadvantages of this form of material?

Based on the responses of the participants, the advantages and disadvantages of the form of material are as follows:

Advantages:

- Integrated Reader.
- Access to text.
- Many navigation options in one menu.

Disadvantages:

- Difficulty navigating the menu (did not like dropdown options).
- Complex shortkeys.
- Unfamiliar to most of them / they have not received any training.
- NVDA and Thorium Reader voices speaking on top of each other.

Overall, it can be concluded that the form of material has both advantages and disadvantages with users finding more disadvantages due to their lack of familiarity with this text format.

Usability Questionnaire

1. How accessible is the material? - The average score of 7.2 out of 10 suggests that the material is somewhat accessible, but could be improved.
2. How difficult was it for you to use it? - The average score of 3.9 suggests that the material is somewhat difficult to use and should be made to be more user-friendly.

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3. To what extent is training required to be able to use it? - The average score of 5.8 suggests that some training is required to use the material effectively, but the level of training required varies.
4. Would you use it if it was available to you? - The average score of 6.4 out of 10 suggests that the availability of the material alone may not be enough to motivate usage, but there is potential for increased usage with important improvements to the material.
5. Would you recommend others to use it? The average score of 7.2 out of 10 suggests that while some individuals may recommend the material to others, overall it may not be highly recommended.
6. To what extent do you believe it will fill gaps of your existent knowledge? - The average score of 7 out of 10 suggests that the material will be effective in filling gaps in knowledge.
7. Could you obtain the information/ knowledge provided by this material in another way? - The average score of 7.3 out of 10 suggests that the information/knowledge provided by the material could be obtained through other sources.
8. Do you think that the material successfully meets the purpose for which it was built? - The average score of 7.4 out of 10 suggests that the material only meets the purpose for which it was built but could be improved.
9. How useful would this material be for your university studies? - The average score of 6.6 out of 10 suggests that the material may not be very useful for university studies.
10. How tedious is the material? - The average score of 4.2 out of 10 suggests that the material is not very tedious.
11. How complex and complicated is the material? - The average score of 3.8 out of 10 suggests that the material is not very complex and complicated.
12. How much load (memory and attention) does the material's use require? - The average score of 5.8 out of 10 suggests that the material's use requires a moderate amount of memory and attention.
13. How satisfied are you with the use of this material? - The average score of 7 out of 10 suggests that the respondents are somewhat satisfied with the use of the material, but there is room for improvement.

Word – Samplebook

Scenarios

Tables 9-11 provide information on the results of an assessment of eleven participants' completion of a task involving a Word Samplebook.

Table 9 shows that all participants were successful in completing the task " Find the sub-heading 'HOW DID PIAGET VIEW COGNITIVE DEVELOPMENT?" in the chapter 'Theories of Development'". The majority of participants completed the task without any help, while three participants received help. Participants who received help took longer to complete the task than those who did not receive help. The average completion time was 57 seconds. Five participants had interruptions during the task with three having only one interruption.

Participants	Success/Unsuccess	With/Without help	Time (sec)	Interruption for solution by himself,	Times of interruption

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ΙΔΡΥΜΑ ΚΡΑΤΙΚΩΝ ΥΠΟΤΡΟΦΙΩΝ IKY

				by help	
P1	S	without	11		0
P2	S	without	31		0
P3	S	with	163	help	2
P4	S	without	48		0
P5	S	without	60	herself	1
P6	S	without	21		0
P7	S	without	30		0
P8	S	without	27	himself	0
P9	S	with	77	help	1
P10	S	with	104	help	1
P11	S	without	65		0

Table 9. First task from Word - Samplebook

Table 10 displays that all participants were successful in completing the task " In the same subchapter‘HOW DID PIAGET VIEW COGNITIVE DEVELOPMENT?”, find the start and the end of ‘FIGURE 2.1 Schemes’." The average completion time was 98 seconds. Four participants needed help to xomplete the task. Most of the participants, who had interruptions, interrupted themselves while completing the task and two had more than one interruption.

Participants	Success/Unsuccess	With/Without help	Time (sec)	Interruption for solution by himself, by help	Times of interruption
P1	S	with	81	himself	1
P2	S	without	195	help	1
P3	S	with	247	himself	4
P4	S	without	132		0
P5	S	without	182	both	3

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P6	S	without	62	himself	1
P7	S	without	73		0
P8	S	with	28	help	1
P9	S	with	16	help	1
P10	S	without	52	himself	0
P11	S	without	18	himself	0

Table 10. The second task from Word – Samplebook

Table 11 shows the results of the third task " After finding sub-chapter 'Example 2: Pie chart', find its accessible form and locate the alternative text and the verbal description for it." The average completion time was 135 seconds. Seven participants completed the task without help. Nine participants had interruptions, most of whom interrupted themselves and three had more than one interruption.

Participants	Success/Unsuccess	With/Without help	Time (sec)	Interruption for solution by himself, by help	Times of interruption
P1	S	with	96	both	3
P2	U	with	302	help	3
P3	S	with	131	himself	3
P4	S	without	174		0
P5	S	without	155	herself	1
P6	S	without	100		0
P7	S	without	246	help	1
P8	S	without	79	himself	0
P9	S	with	35	help	1
P10	S	without	145	himself	0

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P11	S	without	30	himself	0

Table 11. Third task from Word - Samplebook

Independent exploration

During the independent exploration of the Word – Samplebook, the answers of the participants can be broadly classified into three main themes:

- **Amount of information**. Since the book had complex content, participants felt that it would be better if it were divided into smaller files in order to make navigation faster. For instance, time management would be extremely important in case of studying for exams.
- **Verbal description for images and graphs**. Participants would like every verbal description to start with the word "Image" as words like graph or chart confused them.
- **English words**. The screen reader program (NVDA) used did not properly pronounce English names while using synthetic voices for the Greek language. Participants suggested these names be given with Greek letters to avoid such mispronunciations.

Semi-structured interview

The semi-structured interview consisted of 5 questions, which are listed below along with the participants' answers.

1. We would like you to make a general comment on the material. How do you evaluate it (positive / negative)?

- All participants provide a clear positive evaluation of the material.

2. What would you keep and what would you change about it? How (in which way) would you change each item you suggest for a change? Can you suggest some changes and improvements?

- **All participants replied they would not change anything in the material they used during the tasks, except one.**
- **Verbal descriptions**. One participant mentioned they would rather have only a verbal description or an alternative text, not both, which is a prudent suggestion since both were included in the material mainly for the benefit of the study.

3. Could you obtain the information/ knowledge provided by this material in another way? e.g., using some or a combination of some other alternative forms of educational material? What are they? (Should be listed individually or in combination).

- **Alternative formats**. Some participants suggested alternative formats such as pdf, DAISY, wordpad, ePub, printed Braille books and audio-book.
- **Blend of formats**. Two participants suggested keeping the Word format for text and developing tactile material for the pictures included in the textbook.

4. Where do you think this material would be helpful for you during your university studies (in which tasks / activities)?

- Academic tasks
- Lecture notes

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ΙΔΡΥΜΑ ΚΡΑΤΙΚΩΝ ΥΠΟΤΡΟΦΙΩΝ IKY

- Reading
- Exams

All participants agreed that the material would be useful in assignments, reading, exams, and lectures during their university studies. Overall, the participants recognized the value of the material in supporting their academic pursuits and enhancing their learning experience in various contexts, especially for studies in STEM.

5. What are the advantages and disadvantages of this form of material?

Based on the responses of the participants, the advantages and disadvantages of the form of material are as follows:

Advantages:

- Easy to use.
- Provides alternative text for images / visual ibformation.
- Easy to navigate.
- Provides access to information given in various forms (text, image, graph).

Disadvantages:

- ICT skills required.

Overall, the participants had a positive view of the material and identified several advantages. These included the ease of use, provision of alternative text for images, ease of navigation, assistance with understanding images, and marking of important sentences. Some participants could not think of disadvantages and few commented on the ICT edication required as Microsoft Word is familiar to them.

Usability Questionnaire

1. How accessible is the material? - The average response is 9.9 out of 10, indicating that the participants found the material to be highly accessible.
2. How difficult was it for you to use it? - The average response is 1 out of 10, indicating that the participants found the material very easy to use.
3. To what extent is training required to be able to use it? - The average response is 4 out of 10, indicating that the participants believe some level of training may be required to use the material.
4. Would you use it if it was available to you? - The average response is 10, indicating that the participants would absolutely use the material if it was available to them.
5. Would you recommend others to use it? - The average response is 9.7 out of 10, indicating that the participants would likely recommend others to use the material.
6. To what extent do you believe it will fill gaps of your existent knowledge? - The average response is 9.9 out of 10, indicating that the participants believe the material will surely fill some gaps in their knowledge.
7. Could you obtain the information/knowledge provided by this material in another way? - The average response is 5.1 out of 10, indicating that the participants believe that some of the information provided in the material may be obtained through other means.
8. Do you think that the material successfully meets the purpose for which it was built? - The average response is 9.8 out of 10, indicating that the participants believe that the material successfully meets its intended purpose.

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9. How useful would this material be for your university studies? - The average response is 10, indicating that the participants believe the material would be highly useful for their university studies.
10. How tedious is the material? - The average response is 1.4 out of 10, indicating that the participants did not find the material tedious at all.
11. How complex and complicated is the material? - The average response is 2 out of 10, indicating that the participants did not find the material complex or complicated.
12. How much load (memory and attention) does the material's use require? - The average response is 4.9 out of 10, indicating that the participants believe that the material requires some level of memory and attention.
13. How satisfied are you with the use of this material? - The average response is 9.3 out of 10, indicating that the participants are highly satisfied with the use of the material.

PDF – Samplebook

Scenarios

Tables 12-14 provide information on the results of an assessment of eleven participants' completion of a task involving a PDF Samplebook.

Table 12 shows that nine participants were successful in completing the task "Find the sub-heading 'HOW DID PIAGET VIEW COGNITIVE DEVELOPMENT?" in the chapter 'Theories of Development'". The majority of participants completed the task without any help, while three participants received help. The average completion time was 118 seconds. Eight participants had interruptions during the task.

Participants	Success/Unsuccess	With/Without help	Time (sec)	Interruption for solution by himself, by help	Times of interruption
P1	S	without	8		0
P2	S	without	247	help	1
P3	S	with	54		0
P4	S	without	22		0
P5	S	without	101	help	2
P6	U	with	182	help	1
P7	U	with	581	himself	3
P8	S	without	19	himself	0

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P9	S	without	27	himself	0
P10	S	without	46	himself	0
P11	S	without	19	himself	0

Table 12. First task from PDF - Samplebook

Table 13 displays that all participants were successful in completing the task "In the same subchapter‘HOW DID PIAGET VIEW COGNITIVE DEVELOPMENT?”, find the start and the end of ‘FIGURE 2.1 Schemes’". The average completion time was 80 seconds. Two participants needed help to complete the task while the others did not. Most of the participants, who had interruptions, interrupted themselves while completing the task and one had more than one interruptions.

Participants	Success/Unsuccess	With/Without help	Time (sec)	Interruption for solution by himself, by help	Times of interruption
P1	S	without	10		0
P2	S	without	83		0
P3	S	without	151	help	3
P4	S	without	117	herself	1
P5	S	without	46		0
P6	S	with	80	himself	1
P7	S	with	142	himself	1
P8	S	without	6	himself	0
P9	S	without	120	himself	0
P10	S	without	17	himself	0
P11	S	without	111	himself	0

Table 13. Second task from *PDF* – Samplebook

Table 14 shows the results of the third task " After finding sub-chapter ‘Example 2: Pie chart’, find its accessible form and locate the alternative text and the verbal description for it." The average

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completion time was 82 seconds. Ten out of 11 participants completed the task without help. Eight participants had interruptions, most of whom interrupted themselves. One participant had more than one interruptions during the task.

Participants	Success/Unsuccess	With/Without help	Time (sec)	Interruption for solution by himself, by help	Times of interruption
P1	S	without	13		0
P2	S	without	59		0
P3	U	without	65	himself	1
P4	S	without	67		0
P5	U	without	137	help	2
P6	U	without	162	himself	1
P7	S	without	107	himself	1
P8	S	without	22	himself	0
P9	S	without	10	himself	0
P10	S	with	230	help	1
P11	S	without	36	himself	0

Table 14. Third task from PDF - Samplebook

Independent exploration

During the independent exploration of the PDF – Samplebook, participants commented on how accessible and easy-to-use the material was, since they had not expected it. However, the Greek participants faced a technical issue, as the synthetic voice of “Stefanos” read the alternative text as separate letters instead of words. Other synthetic voices for the Greek language did not have the same issues, but “Stefanos” is one of the most common voices used among Greek screen reader users.

Semi-structured interview

The semi-structured interview consisted of 5 questions, which are listed below along with the participants' answers.

1. We would like you to make a general comment on the material. How do you evaluate it (positive / negative)?

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- Nine participants provided a positive evaluation of the material and two gave a moderate evaluation.

2. What would you keep and what would you change about it? How (in which way) would you change each item you suggest for a change? Can you suggest some changes and improvements?

- Participants replied they would not change anything in the material they used during the tasks.

3. Could you obtain the information/ knowledge provided by this material in another way? e.g., using some or a combination of some other alternative forms of educational material? What are they? (Should be listed individually or in combination).

- Participants provided two main suggestions in their answers, **textbooks in Word format and printed Braille books**.

4. Where do you think this material would be helpful for you during your university studies (in which tasks / activities)?

- Academic tasks
- Lecture notes
- Reading
- Exams

All participants agreed that the material would be useful in assignments, reading, exams, and lectures during their university studies. One participant commented that university studies would not be possible without this material.

5. What are the advantages and disadvantages of this form of material?

Based on the responses of the participants, the advantages and disadvantages of the form of material are as follows:

Advantages:

- Easy to use.
- Provides alternative text for images / visual ibformation.
- Easy to navigate.
- Easy to share.
- Widely used text format in higher education institutions.

Disadvantages:

- ICT skills required.
- Inability to alter the material (add notes or copy and paste).
- Tiring.

Overall, the participants had a positive view of the material and identified several advantages. Among them was the fact that PDF texts are widely used in higher education. However, participants found significant disadvantages that may hinder the adoption of this type of material.

Usability Questionnaire

1. How accessible is the material? - The average response is 9.5 out of 10, indicating that the participants found the material to be highly accessible.

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2. How difficult was it for you to use it? - The average response is 2 out of 10, indicating that the participants found the material easy to use.
3. To what extent is training required to be able to use it? - The average response is 4.5 out of 10, indicating that the participants believe some level of training may be required to use the material.
4. Would you use it if it was available to you? - The average response iis 8.9, indicating that the participants would use the material if it was available to them.
5. Would you recommend others to use it? - The average response is 9.5 out of 10, indicating that the participants would likely recommend others to use the material.
6. To what extent do you believe it will fill gaps of your existent knowledge? - The average response is 9.2 out of 10, indicating that the participants believe the material will fill gaps in their knowledge.
7. Could you obtain the information/knowledge provided by this material in another way? - The average response is 6.9 out of 10, indicating that the participants believe that some of the information provided in the material can quite effectively be obtained through other means.
8. Do you think that the material successfully meets the purpose for which it was built? - The average response is 9.2 out of 10, indicating that the participants believe that the material successfully meets its intended purpose.
9. How useful would this material be for your university studies? - The average response is 9.7, indicating that the participants believe the material would be highly useful for their university studies.
10. How tedious is the material? - The average response is 2.4 out of 10, indicating that the participants did not find the material very tedious.
11. How complex and complicated is the material? - The average response is 2.9 out of 10, indicating that the participants did not find the material very complex or complicated.
12. How much load (memory and attention) does the material's use require? - The average response is 4.5 out of 10, indicating that the participants believe that the material requires some level of memory and attention.
13. How satisfied are you with the use of this material? - The average response is 9.4 out of 10, indicating that the participants are highly satisfied with the use of the material.

DAISY – Samplebook

Scenarios

Tables 15-17 provide information on the results of an assessment of six participants' completion of a task involving a DAISY Samplebook. Participants 7-11 did not complete this task.

Table 15 shows that all six participants were successful in completing the task "Find the sub-heading 'HOW DID PIAGET VIEW COGNITIVE DEVELOPMENT?" in the chapter 'Theories of Development'", three without any help and three with help. The average time it took to complete the task across all participants was 81.5 seconds. Four participants had interruptions by help.

Participants	Success/Unsuccess	With/Without help	Time (sec)	Interruption for solution	Times of interruption

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ΙΔΡΥΜΑ ΚΡΑΤΙΚΩΝ ΥΠΟΤΡΟΦΙΩΝ IKY

				by himself, by help	
P1	S	with	7		0
P2	S	with	297	help	3
P3	S	with	96	both	2
P4	S	without	38	both	2
P5	S	without	14		0
P6	S	without	37	help	1

Table 15. First task from DAISY – Samplebook

Table 16 displays that four out of 6 participants were successful in completing the task "In the same subchapter'HOW DID PIAGET VIEW COGNITIVE DEVELOPMENT?", find the start and the end of 'FIGURE 2.1 Schemes'" Four participants completed the task with help and all 6 participants had interruptions during the tast, most more than one, indicating that the task may have been relatively demanding for them. The average time it took to complete the task was 208 seconds.

Participants	Success/Unsuccess	With/Without help	Time (sec)	Interruption for solution by himself, by help	Times of interruption
P1	S	without	141	himself	2
P2	S	without	75	help	1
P3	U	with	301	help	2
P4	S	with	422	help	4
P5	S	with	101	help	1
P6	U	with	208	both	2

Table 16. Second task from DAISY – Samplebook

Table 17 shows the results of the third task " After finding sub-chapter 'Example 2: Pie chart', find its accessible form and locate the alternative text and the verbal description for it." All participants were successful in completing the task. The average completion time was 149 seconds. Five out of 6

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participants had interruptions during the task by either the participants themselves or help and four out of these had more than one interruptions.

Participants	Success/Unsuccess	With/Without help	Time (sec)	Interruption for solution by himself, by help	Times of interruption
P1	S	without	41		0
P2	S	with	335	help	3
P3	S	with	122	both	2
P4	S	with	174	both	3
P5	S	without	95	help	2
P6	S	with	129	help	1

Table 17. Third task from DAISY - Samplebook

Independent exploration

During the independent exploration of the DAISY Samplebook, respondents mentioned their preference for Word, which they consider a simpler and more straightforward format. One participant commented that DAISY textbooks are not widely used in Europe and that he considers them outdated. Another participant reported that DAISY textbooks were unfamiliar to them and that they had never received any training on how to approach this type of material.

Semi-structured interview

The semi-structured interview consisted of 5 questions, which are listed below along with the participants' answers.

1. We would like you to make a general comment on the material. How do you evaluate it (positive / negative)?

- Five participants evaluated the material positively and one negatively. Some participants who evaluated the material positively noted that they would still prefer other formats and that it is unfamiliar to them.

2. What would you keep and what would you change about it? How (in which way) would you change each item you suggest for a change? Can you suggest some changes and improvements?

Participants' unfamiliarity with this type of material had an effect on their suggestions. Most did not know how to answer and those who did made suggestions on the improvement of the software and not the produced material / text itself. Participants suggested making the navigation more user-friendly and implementing less complex shortkeys.

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3. Could you obtain the information/ knowledge provided by this material in another way? e.g., using some or a combination of some other alternative forms of educational material? What are they? (Should be listed individually or in combination).

- **Alternative formats**: Participants mentioned alternative formats that could be used to obtain the same information, including Word, ePub, printed Braille books and audio-books.
- **Blend of formats.** One participants suggested keeping the text as is and developing tactile material for the pictures included in the textbook.

Overall, participants suggested various materials but noted their preference for Word.

4. Where do you think this material would be helpful for you during your university studies (in which tasks / activities)?

- Academic books
- Studying
- Lecture notes

All six participants mentioned the usefulness of the material for studying. One participant also noted again that training is essential in order to be able to use and take full advantage of the provided material in this form.

5. What are the advantages and disadvantages of this form of material?

Based on the responses of the participants, the advantages and disadvantages of the form of material are as follows:

Advantages:

- It can present complex content (text, images and graphs).
- Navigation for headings / sections (fast / responsive).

Disadvantages:

- Lack of ability to make changes to the text.
- Complex navigation (various drop-down menus).
- Unfamiliar.
- Difficult navigation when unfamiliar.
- Tiring.

Overall, it can be concluded that the form of material has both advantages and disadvantages depending on the user's preferences and ICT skills. Participants who noted that this type of material was unfamiliar to them also found it more difficult and tiring to navigate.

Usability Questionnaire

1. How accessible is the material? - The average response is 8.5 out of 10, indicating that the participants found the material to be accessible.
2. How difficult was it for you to use it? - The average response is 4.1 out of 10, indicating that the participants did not find the material easy to use.
3. To what extent is training required to be able to use it? - The average response is 5.5 out of 10, indicating that some training may be required to use the material effectively.
4. Would you use it if it was available to you? - The average response is 5.8 out of 10, indicating that the participants were not very likely to use the material if it was available to them.

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5. Would you recommend others to use it? - The average response is 6.3 out of 10, indicating that the participants were not very likely to recommend the material to others.
6. To what extent do you believe it will fill gaps of your existent knowledge? - The average response is 7.8 out of 10, indicating that the participants believe the material has the potential to fill gaps in their knowledge.
7. Could you obtain the information/knowledge provided by this material in another way? - The average response is 8.5 out of 10, indicating that participants may prefer alternative forms to this one.
8. Do you think that the material successfully meets the purpose for which it was built? - The average response is 8.1 out of 10, indicating that the participants believe the material successfully meets its intended purpose but there is room for improvement.
9. How useful would this material be for your university studies? - The average response is 5.8 out of 10, indicating that the participants believe the material would be not be very useful for their university studies.
10. How tedious is the material? - The average response is 5.8 out of 10, indicating that the participants found the material a little tedious.
11. How complex and complicated is the material? - The average response is 5.6 out of 10, indicating that the participants found the material to be a a little complex and / or complicated.
12. How much load (memory and attention) does the material's use require? - The average response is 7.3 out of 10, indicating that the participants found the material to require a significant degree of memory and attention.
13. How satisfied are you with the use of this material? - The average response is 7.3 out of 10, indicating that the participants were not fully satisfied with the use of the material.

ePub – Samplebook

Scenarios

Tables 18-20 provide information on the results of an assessment of eleven participants' completion of a set of tasks involving an ePub Samplebook. Participant 7 completed only the first task of this set.

Table 18 shows that ten out of 11 participants were successful in completing the task " Find the sub-heading 'HOW DID PIAGET VIEW COGNITIVE DEVELOPMENT?" in the chapter 'Theories of Development'". Six participants completed the task with help. The average completion time was 92 seconds. Interruptions were made by the participants themselves and by help.

Participants	Success/Unsuccess	With/Without help	Time (sec)	Interruption for solution by himself, by help	Times of interruption
P1	S	with	34		0
P2	S	with	110	help	1

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P3	S	with	83		0
P4	S	with	197	help	1
P5	S	with	71	herself	1
P6	S	without	41	himself	1
P7	U	without	352		
P8	S	without	60	himself	0
P9	S	without	25	himself	0
P10	S	with	19	help	1
P11	S	without	25	himself	0

Table 18. First task from ePub – Samplebook

Table 19 displays that nine out of 10 participants were successful in completing the task "In the same subchapter‘HOW DID PIAGET VIEW COGNITIVE DEVELOPMENT?”, find the start and the end of ‘FIGURE 2.1 Schemes’". The average completion time was 95 seconds. Eight participants did not receive help. Five participants interrupted themselves and two were interrupted by help.

Participants	Success/Unsuccess	With/Without help	Time (sec)	Interruption for solution by himself, by help	Times of interruption
P1	U	without	152	himself	1
P2	S	without	91		0
P3	S	with	233	help	1
P4	S	without	101		0
P5	S	without	40		0
P6	S	with	200	help	2
P7	n/a				
P8	S	without	4	himself	0

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P9	S	without	60	himself	0
P10	S	without	5	himself	0
P11	S	without	70	himself	0

Table 19. Second task from ePub – Samplebook

Table 20 shows the results of the third task "After finding sub-chapter 'Example 2: Pie chart', find its accessible form and locate the alternative text and the verbal description for it." Nine out of 10 participants in this task were successful. Seven participants completed the task without help while three received help. Interruptions were caused by both help and participants. The average completion time was 108 seconds.

Participants	Success/Unsuccess	With/Without help	Time (sec)	Interruption for solution by himself, by help	Times of interruption
P1	S	with	118	help	2
P2	S	without	92		0
P3	S	with	186	help	3
P4	S	with	164	help	1
P5	S	without	60	herself	1
P6	U	without	109	help	1
P7	n/a				
P8	S	without	11	himself	0
P9	S	without	240	himself	0
P10	S	without	21	himself	0
P11	S	without	84	himself	0

Table 20. Third task from ePub – Samplebook

Independent exploration

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Participants commented on the unfamiliarity of this type of material. One participant suggested that the ePub material would be more accessible and user-friendly on different software as every experiment was ran on Windows.

Semi-structured interview

The semi-structured interview consisted of 6 questions, which are listed below along with the participants' answers.

1. We would like you to make a general comment on the material. How do you evaluate it (positive / negative)?

- Ten out of 11 participants made a positive evaluation for the material.

2. What would you keep and what would you change about it? How (in which way) would you change each item you suggest for a change? Can you suggest some changes and improvements?

- Most participants did not have any suggestions. Some stated that this was due to the unfamiliarity of this form of material.
- One participant would like simpler shortkeys.
- One participant would like to exlore the material again on iOS software.

3. Could you obtain the information/ knowledge provided by this material in another way? e.g., using some or a combination of some other alternative forms of educational material? What are they? (Should be listed individually or in combination).

- **Preferred Alternative Formats**: Respondents preferred other formats such as Word and PDF. Six partixipants mentioned printed Braille books and one suggested combining Braille text with tactile images. One participant also mentioned DAISY books.

4. Where do you think this material would be helpful for you during your university studies (in which tasks / activities)?

- Academic tasks
- Studyig / Academic books
- Educational material (in general)
- Exams

The participants mentioned different ways in which the material could be helpful during their university studies. However, one mentioned that this material would not be useful in anything at all.

5. What are the advantages and disadvantages of this form of material?

Based on the responses of the participants, the advantages and disadvantages of the form of material are as follows:

Advantages:

- Fast and easy navigation to sections and sub-sections.

Disadvantages:

- Cannot edit the text.
- ICT training required for navigation.
- Unfamiliar.

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- Navigation can be tiring / time-consuming as it requires a combination of movements.

Overall, participants found more disadvantages to the material due to its unfamiliarity.

Usability Questionnaire

1. How accessible is the material? - The average response is 8.2 out of 10, indicating that the participants found the material to be reasonably accessible.
2. How difficult was it for you to use it? - The average response is 3.6 out of 10, suggesting that the participants found the material a little difficult to use.
3. To what extent is training required to be able to use it? - The average response is 5.1 out of 10, indicating that the participants believed that some level of training may be necessary to use the material effectively.
4. Would you use it if it was available to you? - The average response is 7 out of 10, implying that the participants showed a moderate inclination to use the material if it was accessible to them.
5. Would you recommend others to use it? - The average response is 7.6 out of 10, suggesting that the participants were somewhat inclined to recommend the material to others.
6. To what extent do you believe it will fill gaps of your existent knowledge? - The average response is 6.4 out of 10, indicating that the participants were not very positive on the material's ability to fill existing knowledge gaps.
7. Could you obtain the information/ knowledge provided by this material in another way? - The average response is 8.7 out of 10, suggesting that the participants leaned towards alternative means for obtaining the same information/knowledge.
8. Do you think that the material successfully meets the purpose for which it was built? - The average response is 7.4 out of 10, indicating that the participants felt that the material fairly fulfilled its intended purpose.
9. How useful would this material be for your university studies? - The average response is 7 out of 10, suggesting that the participants perceived the material to be moderately useful for their university studies.
10. How tedious is the material? - The average response is 5.1 out of 10, implying that the participants did not find the material excessively tedious.
11. How complex and complicated is the material? - The average response is 4.7 out of 10, indicating that the participants had a neutral perception of the material's complexity and complication level.
12. How much load (memory and attention) does the material’s use require? - The average response is 6.8 out of 10, suggesting that the participants believed the material's use was somewhat demanding on their memory and attention.
13. How satisfied are you with the use of this material? - The average response is 7 out of 10, indicating that the participants expressed a moderate level of satisfaction with the use of the material.

Power Point presentation

Scenarios

Tables 21-25 provides information on the results of an assessment of eleven participants' completion tasks involving a Power Point presentation.

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Table 21 shows the results of the first task "Locate the table that is in the presentation". Six participants were successful in completing the task and five were not. The average completion time was 82 seconds.

Participants	Success/Unsuccess	With/Without help	Time (sec)	Interruption for solution by himself, by help	Times of interruption
P1	S	with	20	both	2
P2	S	without	43		0
P3	U	without	23	help	1
P4	U	with	412	help	0
P5	U	with	81	herself	1
P6	U	without	22		0
P7	U	without	171	help	1
P8	S	with	5	himself	0
P9	S	without	24	himself	0
P10	S	without	102	help	1
P11	S	without	5	himself	0

Table 21. First task from Power Point

Table 22 shows that all participants were successful in completing the task "Locate slide 4" without any help. The completion time was very short with an average of 5 seconds. Interruptions during the task existed for four participants.

Participants	Success/Unsuccess	With/Without help	Time (sec)	Interruption for solution by himself, by help	Times of interruption
P1	S	without	3		0

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P2	S	without	5		0
P3	S	without	3		0
P4	S	without	4		0
P5	S	without	6		0
P6	S	without	7		0
P7	S	without	6		0
P8	S	without	3	himself	0
P9	S	without	2	himself	0
P10	S	without	4	help	1
P11	S	without	15	himself	0

Table 22. Second task from Power Point

Table 23 shows the results of the third task "Locate all images in the presenation. All participants were successful in completing the task, out of whom 9 did so without help. The average completion time for the task was 59 seconds. Interruptions were recorded for seven participants.

Participants	Success/Unsuccess	With/Without help	Time (sec)	Interruption for solution by himself, by help	Times of interruption
P1	S	without	14		0
P2	S	without	27		0
P3	S	with	113	help	1
P4	S	with	99		1
P5	S	without	61		0
P6	S	without	22	himself	1
P7	S	without	69	himself	1

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P8	S	without	23	himself	0
P9	S	without	10	himself	0
P10	S	without	186	himself	0
P11	S	without	25	himself	0

Table 23. Third task from Power Point

Table 24 shows the results of the fourth task " Locate the slide with the heading 'Political rights'". All participants succeeded in completing the task with only one needing help. The average time was 21 seconds. Some interruptions took place during the task, mainly by the participants themselves.

Participants	Success/Unsuccess	With/Without help	Time (sec)	Interruption for solution by himself, by help	Times of interruption
P1	S	without	8		0
P2	S	without	7		0
P3	S	without	34		0
P4	S	with	44		0
P5	S	without	7		0
P6	S	without	34	himself	1
P7	S	without	20		0
P8	S	without	70	help	1
P9	S	without	4	himself	0
P10	S	without	9	himself	0
P11	S	without	3	himself	0

Table 24. Fourth task from Power Point

Table 25 shows the results of the fifth task "Locate the slides which have numbered items". All participants were successful in completing the task with one only one participant requiring help. The

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average completion time was 46 seconds. There were interruptions during the task made by the participants and by the help.

Participants	Success/Unsuccess	With/Without help	Time (sec)	Interruption for solution by himself, by help	Times of interruption
P1	S	without	16		0
P2	S	without	45		0
P3	S	without	72	help	1
P4	S	with	98	help	3
P5	S	without	65	help	1
P6	S	without	46	himself	1
P7	S	without	66		0
P8	S	without	30	himself	0
P9	S	without	8	himself	0
P10	S	without	54	himself	0
P11	S	without	6	himself	0

Table 25. Fifth task from Power Point

Independent exploration

- **Overall evaluation / commentary**: Participants provided an overall positive evaluation of the ppt. Participants were impressed with the material and noted two main things: a) that in general they do not get the opportunity to handle PowerPoint presentations so they are not familiar with their navigation, and b) that usually, even when PowerPoint presentations are given to them as "accessible", they are not as people -usually professors- who create presentations want them to be impressive and use a lot of colors and patterns which make them inaccessible for people with VI.

Semi-structured interview

The semi-structured interview consisted of 5 questions, which are listed below along with the participants' answers.

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1. We would like you to make a general comment on the material. How do you evaluate it (positive / negative)?

- All participants evaluated the material positively.

2. What would you keep and what would you change about it? How (in which way) would you change each item you suggest for a change? Can you suggest some changes and improvements?

- **Positive evaluation of the material**: "Very helpful".
- **Keeping the material as is**: "I wouldn't change anything"
- It seems that the material was well-received by the participants and exceeded their expectations.

3. Could you obtain the information/ knowledge provided by this material in another way? e.g., using some or a combination of some other alternative forms of educational material? What are they? (Should be listed individually or in combination).

- **Alternative formats**: Participants did not mention any other programs for presentations. Nevertheless, most participants mentioned that they could obtain the same information provided by the material using a Word document. Other forms mentioned were: text, tactile material, audio files and PDF.

The participants seem to rely on the familiarity of Word documents.

4. Where do you think this material would be helpful for you during your university studies (in which tasks / activities)?

- Lectures (where lacturers / professors use presentations)
- Presenting their own academic projects
- Studying

Overall, the participants found the material to be useful mainly during lectures where professors tend to use presentations, but they would also like to use them themselves for their own academic work.

5. What are the advantages and disadvantages of this form of material?

Based on the responses of the participants, the advantages and disadvantages of the form of material are as follows:

Advantages:

- Ability to have the main points from a material which is usually inaccessible.
- Fully accessible / equal access
- Easy navigation.
- Use of lists is facilitating.

Disadvantages:

- Inability to change the page with the same keys in "Presentation" and "Creation" function modes.
- ICT training required.

Overall, the participants found more advantages than disadvantages of this form of material.

Usability Questionnaire

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ΙΔΡΥΜΑ ΚΡΑΤΙΚΩΝ ΥΠΟΤΡΟΦΙΩΝ IKY

1. How accessible is the material? - The average response is 9.4 out of 10, indicating that the participants found the material to be very accessible.
2. How difficult was it for you to use it? - The average response is 2 out of 10 indicating that the participants found the material easy to use.
3. To what extent is training required to be able to use it? - The average response is 4.7 out of 10, indicating that some level of training may be required to use the material effectively.
4. Would you use it if it was available to you? - The average response is 9 out of 10, indicating that the participants would be likely to use the material if it was available to them.
5. Would you recommend others to use it? - The average response is 9 out of 10, indicating that the participants would be likely to recommend the material to others.
6. To what extent do you believe it will fill gaps of your existent knowledge? - The average response is 8.3 out of 10, indicating that the participants believe the material has the potential to fill gaps in knowledge.
7. Could you obtain the information/ knowledge provided by this material in another way? - The average response is 8.2 out of 10, indicating that participants believe the information could be obtained through other means. This may be due to the former experience of the participants with inaccessible presentations as one participant noted.
8. Do you think that the material successfully meets the purpose for which it was built? - The average response is 8.9 out of 10, indicating that the participants believe the material is successful in meeting its purpose.
9. How useful would this material be for your university studies? - The average response is 9.1 out of 10, indicating that the participants believe the material would be quite useful for their university studies.
10. How tedious is the material? - The average response is 2.4 out of 10, indicating that the participants did not find the material very tedious.
11. How complex and complicated is the material? - The average response is 3.1 out of 10, indicating that the participants did not find the material very complex or complicated.
12. How much load (memory and attention) does the material's use require? - The average response is 3.6 out of 10, indicating that the participants found the material to require a low level of memory and attention.
13. How satisfied are you with the use of this material? - The average response is 8.9 out of 10, indicating that the participants were satisfied with the use of the material.

Verbal descriptions

Scenarios

Tables 26-32 provide information on the results of an assessment of participants' completion of a task involving verbal descriptions of images. The task was for the participant to "Go to image X. Listen to it as many times as you need. Then, describe to us what is in the image.", which participants had to do for each of the seven provided images.

Table 26 shows that ten out of 11 participants were successful in completing the task for the first image described. The average time taken by the participants to provide the description of first image was 236 seconds.

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Participants	Success/Unsuccess	With/Without help	Time (sec)	Interruption for solution by himself, by help	Times of interruption
P1	S	without	97	himself	3
P2	U	help	385	help	3
P3	S	help	585	help	4
P4	S	without	516	both	3
P5	S	without	146		0
P6	S	without	236		0
P7	S	without	317		0
P8	S	without	88	himself	0
P9	S	without	64	himself	0
P10	S	without	76	himself	0
P11	S	without	87	himself	0

Table 26. Verbal description of 1st image "The solar System"

Table 27 shows that eight out of 11 participants were successful in completing the task for the second image described. The average time taken by the participants to provide the description of second image was 257 seconds.

Participants	Success/Unsuccess	With/Without help	Time (sec)	Interruption for solution by himself, by help	Times of interruption
P1	S	with	169		0
P2	S	without	480	help	1
P3	U	with	445	help	1
P4	U	with	477	both	2

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P5	S	without	154	help	1
P6	U	without	458	himself	2
P7	S	without	407	help	1
P8	S	without	80	himself	0
P9	S	without	56	himself	0
P10	S	without	23	himself	0
P11	S	without	78	himself	0

Table 27. Verbal description of 2nd image "The Empire of Alexander the Great"

Table 28 shows that six out of 11 participants were successful in completing the task for the third image described. The average time taken by the participants to provide the description of third image was 170 seconds.

Participants	Success/Unsuccess	With/Without help	Time (sec)	Interruption for solution by himself, by help	Times of interruption
P1	U	without	231		0
P2	U	without	297		0
P3	S	with	142	help	1
P4	U	with	217		0
P5	U	without	126		0
P6	S	without	190	help	1
P7	U	without	121	help	1
P8	S	without	275	himself	0
P9	S	without	30	himself	0
P10	S	without	113	himself	0

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P11	S	without	131	himself	0

Table 28. Verbal description of 3rd image "The Earth's magnetic field"

Table 29 shows that all participants were successful in completing the task for the fourth image described, ten of them without any help. The average time taken by the participants to provide the description of fourth image was 144 seconds.

Participants	Success/Unsuccess	With/Without help	Time (sec)	Interruption for solution by himself, by help	Times of interruption
P1	S	without	78	help	1
P2	S	without	235	herself	0
P3	S	without	182	help	0
P4	S	without	207	herself	1
P5	S	with	125	help	1
P6	S	without	195		0
P7	S	without	204		0
P8	S	without	90	himself	0
P9	S	without	103	himself	0
P10	S	without	78	himself	0
P11	S	without	92	himself	0

Table 29. Verbal description of 4th image "Bar graph presenting the birthdays of students in a class by month"

Table 30 shows that nine out of 11 participants were successful in completing the task for the fifth image described and most participants did not receive any help. The average time taken by the participants to provide the description of fifth image was 240 seconds.

Participants	Success/Unsuccess	With/Without	Time	Interruption for solution	Times of

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		help	(sec)	by himself, by help	interruption
P1	S	without	194		0
P2	S	with	619		1
P3	S	without	328		0
P4	S	without	293	herself	2
P5	U	with	325	help	1
P6	S	without	229		0
P7	U	without	146		0
P8	S	without	104	himself	0
P9	S	without	115	himself	0
P10	S	without	155	himself	0
P11	S	without	132	himself	0

Table 30. Verbal description of 5th image "- Flowchart depicting the process of dealing with a non-working light bulb"

Table 31 shows that ten out of 11 participants were successful in completing the task for the sixth image described and most of the participants did not receive any help. The average time taken by the participants to provide the description of sixth image was 172 seconds.

Participants	Success/Unsuccess	With/Without help	Time (sec)	Interruption for solution by himself, by help	Times of interruption
P1	S	with	102	help	1
P2	S	without	290		0
P3	S	without	249		1
P4	S	with	299	help	1

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P5	S	without	120		0
P6	U	without	229	himself	2
P7	S	without	122		0
P8	S	without	49	himself	0
P9	S	without	134	himself	0
P10	S	without	169	himself	0
P11	S	without	138	himself	0

Table 31. Verbal description of 6th image "Stacked bar chart presenting the preferred sports in a 6th grade class"

Table 32 shows that all participants were successful in completing the task for the seventh image described without any help. The average time taken by the participants to provide the description of seventh image was 162 seconds.

Participants	Success/Unsuccess	With/Without help	Time (sec)	Interruption for solution by himself, by help	Times of interruption
P1	S	without	71		0
P2	S	without	239		0
P3	S	without	277	help	1
P4	S	without	171		
P5	S	without	229	herself	2
P6	S	without	203	himself	1
P7	S	without	150		0
P8	S	without	96	himself	0
P9	S	without	113	himself	0
P10	S	without	122	himself	0

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P11	S	without	112	himself	0

Table 32. Verbal description of 7th image "Line chart presenting the food sold per day"

Comprehension questions

For each image, there were 2 comprehension questions. The participants' performance was as follows:

- Image 1: Nine out of 11 participants answered correctly to both comprehension questions, which were: 1.1 " Which is the fifth planet??" and 1.2 " On which orbit is the comet located?"
- Image 2: None out of 11 participants answered correctly on comprehension question 2.1 "In which direction did Alexander the Great's army move when it started from Macedonia?" and ten out of 11 participants answered correctly to the comprehension question 2.2 "Where on the map is Persia located?".
- Image 3: Ten out of 11 participants answered correctly to comprehension question 3.1 "What does the center of the circle represent?" and 3.2 "What direction do the curved lines representing the forces of the field have?".
- Image 4: All participants answered question 4.1 correctly, "Which month has the most students' birthdays?" and ten out of 11 answered correctly question 4.2 "How many students have birthdays in March?"
- Image 5: Seven out of 11 participants answered question 5.1 correctly, "How does the process start?" and nine out of 11 answered correctly question 5.2 "What should you do if the bulb is not burnt out?"
- Image 6: All participants answered both of the following questions correctly: 6.1 "Which sport do boys prefer more?" and 6.2 "How many students prefer tennis?"
- Image 7: All participants answered the following question correctly: 7.1 "On which days do sales increase?" and ten out of 11 answered correctly question 7.2 "How many hot dogs were sold on Wednesday?"

Semi-structured interview

The semi-structured interview consisted of 5 questions, which are listed below along with the participants' answers.

1. We would like you to make a general comment on the material. How do you evaluate it (positive / negative)?

- All participants evaluated the material positively.

2. What would you keep and what would you change about it? How (in which way) would you change each item you suggest for a change? Can you suggest some changes and improvements?

- **Positive evaluation of the material**: "useful", "well developed".
- **Making a change while keeping most of the material intact**: For example, "a different axis could be used for describing the map", "I would put less information", "I would make it simpler".

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Overall, the participants evaluated the material positively, finding it helpful and informative. Most participants expressed a desire to keep most of the material as is, with some minor changes such as reducing the amount of information. These suggestions may reflect a preference for a more concise approach to presenting information.

3. Could you obtain the information/ knowledge provided by this material in another way? e.g., using some or a combination of some other alternative forms of educational material? What are they? (Should be listed individually or in combination).

- **Alternative formats**: All participants mentioned that they could obtain the same information or knowledge provided by the material using tactile forms such as tiger embossed print or microcapsule material, audio-visual form (combined with verbal descriptions). One participant mentioned 3D printing and another mentioned AI and / or an assistant.

4. Where do you think this material would be helpful for you during your university studies (in which tasks / activities)?

- Studying
- Lectures
- Mainly in STEM / lessons that include graphs, for example, mathematics, statistics.

One participant also reported that the material would be useful everywhere as visual information surrounds us constantly.

5. What are the advantages and disadvantages of this form of material?

Based on the participants' responses, we can group the advantages and disadvantages of the material into the following themes:

Advantages:

- Detailed information and descriptions that ensure there is no misconceptions as can be done when exploring tactile material on your own.
- Useful
- Helpful
- Easy
- Interractive
- Well organized information (you do not have to find everything yourself as you do with tactile material)
- Reliable
- Clear information

Disadvantages:

- Time consuming.
- Too much information.
- Tiring.
- Demands knowledge

In general, the participants seemed to appreciate the detailed information and descriptions provided by the material, but some found it overwhelming especially concerning the 2nd image which presented a very detailed map.

Usability Questionnaire

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1. How accessible is the material? - The average response is 9.5 out of 10, indicating that the participants found the material to be highly accessible.
2. How difficult was it for you to use it? - The average response is 1.2 out of 10, indicating that the participants did not find the material difficult to use.
3. To what extent is training required to be able to use it? - The average response is 3.1 out of 10, indicating that the participants believed that a little training was required to use the material.
4. Would you use it if it was available to you? - The average response is 8.8 out of 10, indicating that the participants would use the material if it was available to them.
5. Would you recommend others to use it? - The average response is 9.5 out of 10, indicating that the participants would highly recommend others to use the material.
6. To what extent do you believe it will fill gaps of your existent knowledge? - The average response is 9.2 out of 10, indicating that the participants believed the material would fill gaps in their knowledge to a high extent.
7. Could you obtain the information/knowledge provided by this material in another way? - The average response is 6.4 out of 10, indicating that some participants believed that they could obtain the information provided by the material in other ways.
8. Do you think that the material successfully meets the purpose for which it was built? - The average response is 9.2 out of 10, indicating that the participants believed the material successfully meets its intended purpose.
9. How useful would this material be for your university studies? - The average response is 9.1 out of 10, indicating that the participants found the material to be highly useful for their university studies.
10. How tedious is the material? - The average response is 2.4 out of 10, indicating that the participants did not find the material to be very tedious.
11. How complex and complicated is the material? - The average response is 2.7 out of 10, indicating that the participants did not find the material to be very complex or complicated.
12. How much load (memory and attention) does the material's use require? - The average response is 6.5 out of 10, indicating that some participants found the material to require a moderate amount of memory and attention.
13. How satisfied are you with the use of this material? - The average response is 9.1 out of 10, indicating that the participants were highly satisfied with the use of the material.

Tactile microcapsule

Tactile microcapsule was an education tool presenting seven images, each one had one to two tasks and two comprehension questions. The images in this task were the same that were discussed in the previous tasks for verbal description. Tasks were marked with "Success" if completed successfully and "Unsuccess" if they were not. Time spent in each task, the existence of interruptions and their duration and the need of additional help were also collected as data.

There are no data for Participants 2 and 7 as both did not know Braille and were exempt from these tasks.

Scenarios

Image 1- The solar system

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Table 33 presents data from task 1 (Locate Mars). All of the nine participants were successful in completing the task without help. The average completion time was 50 seconds.

Participants	Success/Unsuccess	With/Without help	Time (sec)	Interruption for solution by himself, by help	Times of interruption
P1	S	without	6		0
P3	S	without	72		0
P4	S	without	13		0
P5	S	without	5		0
P6	S	without	9		0
P8	S	without	135	himself	1
P9	S	without	67	himself	1
P10	S	without	78	himself	1
P11	S	without	69	himself	1

Table 33. First task from TACTILE MICROCAPSULE (The solar system)

Table 34 presents data from task 2 (Locate the rays of the sun). All of the nine participants were successful in completing the task without help. The average completion time was 41 seconds.

Participants	Success/Unsuccess	With/Without help	Time (sec)	Interruption for solution by himself, by help	Times of interruption
P1	S	without	2		0
P3	S	without	71		0
P4	S	without	5		0
P5	S	without	3		0

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P6	S	without	2		0
P8	S	without	87	himself	1
P9	S	without	46	himself	1
P10	S	without	119	himself	1
P11	S	without	39	himself	1

Table 34: Second task from TACTILE MICROCAPSULE (The solar system)

Eight of 9 participants answered correctly to both comprehension questions, while P3 answered both wronly. The questions were:

Q1: Which is the fifth planet?

Q2: On which orbit is the comet located?

Participants	Question 1	Question 2
P1	Correct	Correct
P3	Wrong	Wrong
P4	Correct	Correct
P5	Correct	Correct
P6	Correct	Correct
P8	Correct	Correct
P9	Correct	Correct
P10	Correct	Correct
P11	Correct	Correct

Table 35. Comprehension questions (The solar system)

Image 2- The Empire of Alexander the Great

Table 36 presents data from the task “Locate the city of Babylon”. All of the nine participants were successful in completing the task, seven of them without help. The average completion time was 99 seconds.

Participants	Success/Unsuccess	With/Without help	Time (sec)	Interruption for solution by himself,	Times of interruption

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				by help	
P1	S	without	142	help	1
P3	S	with	127	both	3
P4	S	without	26		0
P5	S	with	135		0
P6	S	without	84	himself	1
P8	S	without	189	himself	1
P9	S	without	128	himself	1
P10	S	without	45	himself	1
P11	S	without	23	himself	1

Table 36. Task from TACTILE MICROCAPSULE (The Empire of Alexander the Great)

Eight of 9 participants answered correctly to both comprehension questions, while P3 answered both wronly. The questions were:

Q1: In which direction did Alexander the Great's army move when it started from Macedonia?

Q2: Where on the map is Persia located?

Participants	Question 1	Question 2
P1	Correct	Correct
P3	Wrong	Wrong
P4	Correct	Correct
P5	Correct	Correct
P6	Correct	Correct
P8	Correct	Correct
P9	Correct	Correct
P10	Correct	Correct
P11	Correct	Correct

Table 37. Comprehension questions (The Empire of Alexander the Great)

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Image 3-Earth's magnetic field

Table 38 presents data from task 1 (Locate the equator.). All of the nine participants were successful in completing the task without help. The average completion time was 60 seconds.

Participants	Success/Unsuccess	With/Without help	Time (sec)	Interruption for solution by himself, by help	Times of interruption
P1	S	without	3		0
P3	S	without	24		0
P4	S	without	2		0
P5	S	without	25		0
P6	S	without	4		0
P8	S	without	97	himself	1
P9	S	without	105	himself	1
P10	S	without	171	himself	1
P11	S	without	110	himself	1

Table 38. First task from TACTILE MICROCAPSULE (Earth's magnetic field)

Table 39 presents data from task 2 (Locate the magnetic north.). All of the nine participants were successful in completing the task without help. The average completion time was 58 seconds.

Participants	Success/Unsuccess	With/Without help	Time (sec)	Interruption for solution by himself, by help	Times of interruption
P1	S	without	11		0
P3	S	without	27		0
P4	S	without	40		0
P5	S	without	6		0

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P6	S	without	9		0
P8	S	without	186	himself	1
P9	S	without	12	himself	1
P10	S	without	144	himself	1
P11	S	without	92	himself	1

Table 39. Second task from TACTILE MICROCAPSULE (Earth's magnetic field)

All participants answered the first question correctly and eight of 9 participants answered the second question correctly. The questions were:

Q1: What does the center of the circle represent?

Q2: What direction do the curved lines representing the forces of the field have?

Participants	Question 1	Question 2
P1	Correct	Correct
P3	Wrong	Correct
P4	Correct	Correct
P5	Correct	Correct
P6	Correct	Correct
P8	Correct	Correct
P9	Correct	Correct
P10	Correct	Correct
P11	Correct	Correct

Table 40. Comprehension questions (Earth's magnetic field)

Image 4- Bar graph presenting the birthdays of students in a class by month

Table 41 presents data from task 1 (Locate the month of July on the horizontal axis). Eight of the nine participants were successful in completing the task with only one receiving help. The average completion time was 29.8 seconds.

Participants	Success/Unsuccess	With/Without help	Time (sec)	Interruption for solution by himself,	Times of interruption

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ΙΔΡΥΜΑ ΚΡΑΤΙΚΩΝ ΥΠΟΤΡΟΦΙΩΝ IKY

				by help	
P1	U	without	11		0
P3	S	without	4		0
P4	S	with	34		0
P5	S	without	5		0
P6	S	without	30		0
P8	S	without	55	himself	1
P9	S	without	28	himself	1
P10	S	without	42	himself	1
P11	S	without	60	himself	1

Table 41. First task from TACTILE MICROCAPSULE (Bar graph presenting the birthdays of students)

Table 42 presents data from task 2 (Identify the highest number on the vertical axis). All of the nine participants were successful in completing the task without help. The average completion time was 49 seconds.

Participants	Success/Unsuccess	With/Without help	Time (sec)	Interruption for solution by himself, by help	Times of interruption
P1	S	without	1	himself	1
P3	S	without	36	help	1
P4	S	without	6		0
P5	S	without	7		0
P6	S	without	4		0
P8	S	without	112	himself	1
P9	S	without	26	himself	1

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P10	S	without	151	himself	1
P11	S	without	98	himself	1

Table 42. Second task from TACTILE MICROCAPSULE (Bar graph presenting the birthdays of students)

All participants answered the first question correctly and eight of 9 participants answered the second question correctly. The questions were:

Q1: Which month has the most students' birthdays?

Q2: How many students have birthdays in March?

Participants	Question 1	Question 2
P1	Correct	Correct
P3	Correct	Correct
P4	Correct	Wrong
P5	Correct	Correct
P6	Correct	Correct
P8	Correct	Correct
P9	Correct	Correct
P10	Correct	Correct
P11	Correct	Correct

Table 43. Comprehension questions (Bar graph presenting the birthdays of students)

Image 5- Flowchart depicting the process of dealing with a non-working light bulb

Table 44 presents data from task 1 (Locate the rectangle indicating the start of the process.). All of the nine participants were successful in completing the task without help. The average completion time was 49 seconds.

Participants	Success/Unsuccess	With/Without help	Time (sec)	Interruption for solution by himself, by help	Times of interruption
P1	S	without	3		0
P3	S	without	1		0

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P4	S	without	1		0
P5	S	without	2		0
P6	S	without	3		0
P8	S	without	199	himself	1
P9	S	without	82	himself	1
P10	S	without	24	himself	1
P11	S	without	130	himself	1

Table 44. First task from TACTILE MICROCAPSULE (Flowchart depicting the process of dealing with a non-working light bulb)

Table 45 presents data from task 2 (Identify the arrows with the answer "no"). All of the nine participants were successful in completing the task without help. The average completion time was 83.7 seconds.

Participants	Success/Unsuccess	With/Without help	Time (sec)	Interruption for solution by himself, by help	Times of interruption
P1	S	without	9		0
P3	S	without	33		0
P4	S	without	69		0
P5	S	without	10		0
P6	S	without	7		0
P8	S	without	152	himself	1
P9	S	without	139	himself	1
P10	S	without	180	himself	1
P11	S	without	155	himself	1

Table 45. Second task from TACTILE MICROCAPSULE (Flowchart depicting the process of dealing with a non-working light bulb)

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Eight out of 9 participants answered both questions correctly, P4 replied wrongly to the first and P3 replied wrongly to the second. The questions were:

Q1: How does the process start?

Q2: What should you do if the bulb is not burnt out?

Participants	Question 1	Question 2
P1	Correct	Correct
P3	Correct	Wrong
P4	Wrong	Correct
P5	Correct	Correct
P6	Correct	Correct
P8	Correct	Correct
P9	Correct	Correct
P10	Correct	Correct
P11	Correct	Correct

Table 46. Comprehension questions (Flowchart depicting the process of dealing with a non-working light bulb)

Image 6-Stacked bar chart presenting the preferred sports in a 6th grade class

Table 47 presents data from task 1 (Locate tennis on the horizontal axis). Eight out of the nine participants were successful in completing the task without help. The average completion time was 39 seconds.

Participants	Success/Unsuccess	With/Without help	Time (sec)	Interruption for solution by himself, by help	Times of interruption
P1	S	without	3		0
P3	S	without	5		0
P4	U	without	14		0
P5	S	without	3		0

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P6	S	without	4		0
P8	S	without	47	himself	1
P9	S	without	89	himself	1
P10	S	without	18	himself	1
P11	S	without	169	himself	1

Table 47. First task from TACTILE MICROCAPSULE (Stacked bar chart presenting the preferred sports in a 6th grade class)

Table 48 presents data from task 2 (Locate the section of the bar representing girls who like tennis). Seven out of the nine participants were successful in completing the task without help. The average completion time was 38 seconds.

Participants	Success/Unsuccess	With/Without help	Time (sec)	Interruption for solution by himself, by help	Times of interruption
P1	S	without	6		0
P3	U	without	20		0
P4	U	without	3		0
P5	S	without	2		0
P6	S	without	3		0
P8	S	without	133	himself	1
P9	S	without	141	himself	1
P10	S	without	13	himself	1
P11	S	without	22	himself	1

Table 48. Second task from TACTILE MICROCAPSULE (Stacked bar chart presenting the preferred sports in a 6th grade class)

All participants answered the first question correctly and eight out of 9 participants answered the second question correctly. The questions were:

Q1: Which sport do boys prefer more?

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Q2: How many students prefer tennis?

Participants	Question 1	Question 2
P1	Correct	Wrong
P3	Correct	Correct
P4	Correct	Correct
P5	Correct	Correct
P6	Correct	Correct
P8	Correct	Correct
P9	Correct	Correct
P10	Correct	Correct
P11	Correct	Correct

Table 49. Comprehension questions (Stacked bar chart presenting the preferred sports in a 6th grade class)

Image 7- Line chart presenting the food sold per day

Table 50 presents data from task 1 (Locate the horizontal axis.). Eight out of nine participants were successful in completing the task without help. The average completion time was 58 seconds.

Participants	Success/Unsuccess	With/Without help	Time (sec)	Interruption for solution by himself, by help	Times of interruption
P1	S	without	3		0
P3	U	without	13		0
P4	S	without	31		0
P5	S	without	3		0
P6	S	without	1		0
P8	S	without	171	himself	1
P9	S	without	40	himself	1
P10	S	without	161	himself	1

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P11	S	without	100	himself	1

Table 50. First task from TACTILE MICROCAPSULE (Line chart presenting the food sold per day)

Table 51 presents data from task 2 (Locate the line representing hot dogs). Eight out of nine participants were successful in completing the task, most of them without help. The average completion time was 60 seconds.

Participants	Success/Unsuccess	With/Without help	Time (sec)	Interruption for solution by himself, by help	Times of interruption
P1	S	without	58		0
P3	S	with	99		0
P4	U	with	63		0
P5	S	without	10		0
P6	S	without	12		0
P8	S	without	118	himself	1
P9	S	without	28	himself	1
P10	S	without	55	himself	1
P11	S	without	103	himself	1

Table 51. Second task from TACTILE MICROCAPSULE (Line chart presenting the food sold per day)

Eight out of nine participants answered both questions correctly while P4 answered them wrongly. The questions were:

Q1: On which days do the sales increase?

Q2: How many hot dogs were sold on Wednesday?

Participants	Question 1	Question 2
P1	Correct	Correct
P3	Correct	Correct

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P4	Wrong	Wrong
P5	Correct	Correct
P6	Correct	Correct
P8	Correct	Correct
P9	Correct	Correct
P10	Correct	Correct
P11	Correct	Correct

Table 52. Comprehension questions (Line chart presenting the food sold per day)

Semi-structured interview

The answers in the five questions are presented below.

1. We would like you to make a general comment on the material. How do you evaluate it (positive / negative)?

- All participants evaluated the material positively.

2. What would you keep and what would you change about it? How (in which way) would you change each item you suggest for a change? Can you suggest some changes and improvements?

- **Most participants would not change anything.** Particpants would keep the legend for the map as it is very helpful for complex images. One participant liked the contrast.
- Some of the participants would keep most of the material but make minor changes. **Suggested changes**: Participants would improve the Braille letters and especially their quality as to make the texture more intense and durable to wear.

3. Could you obtain the information/ knowledge provided by this material in another way? e.g., using some or a combination of some other alternative forms of educational material? What are they? (Should be listed individually or in combination).

- **Alternative format**: Tiger embossed prints, audio-tactile material, alternative text, verbal description.

4. Where do you think this material would be helpful for you during your university studies (in which tasks / activities)?

- Supplementary material (to presentations, studying, lecture notes, exams)
- Courses with diagrams or maps (ex. STEM, History)
- Practical courses

5. What are the advantages and disadvantages of this form of material?

Based on the participants' responses, we can group the advantages and disadvantages of the material into the following themes:

Advantages:

- Understandable (some information would not be so understandable in a verbal description)

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- Fully and quickly accessible
- Detailed

Disadvantages:

- Need for familiarization with the material
- Time-consuming (if you are new to this type of material and do not know how to process it)
- Braille dots too close to each other / have faded (for the last participants).
- Indistinguishable where lines meet each other (for complex images)
- Not widely available to them (and as a result unfamiliar)

Usability Questionnaire

1. How accessible is the material? - The average response is 9.2 out of 10, indicating that the participants found the material to be very accessible.
2. How difficult was it for you to use it? - The average response is 3 out of 10, indicating that the participants found the material relatively easy to use.
3. To what extent is training required to be able to use it? - The average response is 4.6 out of 10, indicating that the participants felt that some level of training may be required to use the material.
4. Would you use it if it was available to you? - The average response is 9.8 out of 10, indicating that the participants would definitely use the material if it were available to them.
5. Would you recommend others to use it? - The average response is 9.8 out of 10, indicating that the participants would very likely recommend others to use the material.
6. To what extent do you believe it will fill gaps of your existent knowledge? - The average response is 9.4 out of 10, indicating that the participants surely believe that the material fills gaps in their knowledge.
7. Could you obtain the information/knowledge provided by this material in another way? - The average response is 5.6 out of 10, indicating that the participants were ambivalent about obtaining the same information elsewhere.
8. Do you think that the material successfully meets the purpose for which it was built? - The average response is 9 out of 10, indicating that the participants felt that the material meets its intended purpose.
9. How useful would this material be for your university studies? - The average response is 8.2 out of 10, indicating that the participants believe the material is useful for their university studies.
10. How tedious is the material? - The average response is 2.8 out of 10, indicating that some participants did not find it very tedious.
11. How complex and complicated is the material? - The average response is 3.6 out of 10, indicating that the participants did not find the material very complex or complicated.
12. How much load (memory and attention) does the material's use require? - The average response is 3.6 out of 10, indicating that the participants believe that the material does not requires a significant amount of memory and attention.
13. How satisfied are you with the use of this material? - The average response is 9.2 out of 10, indicating that the participants were satisfied with the use of the material.

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Tactile tiger prints

Tactile tiger embossed prints were an education tool presenting seven images, each one had one to two tasks and two comprehension questions. The images in this task were the same that were discussed in the previous tasks for verbal description and tactile microcapsule material. Tasks were marked with "Success" if completed successfully and "Unsuccess" if they were not. Time spent in each task, the existence of interruptions and their duration and the need of additional help were also collected as data.

There are no data for Participants 2 and 7 as both did not know Braille and were exempt from these tasks. There are no available date for P8-P11 as they did not complete these tasks.

Scenarios

Image 1- The solar system

Table 53 presents data from task 1 (Locate Mars). Four out of five participants were successful in completing the task without help. The average completion time was 47.8 seconds.

Participants	Success/Unsuccess	With/Without help	Time (sec)	Interruption for solution by himself, by help	Times of interruption
P1	S	without	53	himself	1
P3	S	without	4		0
P4	U	with	124		0
P5	S	without	14		0
P6	S	without	44		0

Table 53. First task from TIGER PRINTS (The solar system)

Table 54 presents data from task 2 (Locate the rays of the sun). Four out of five participants were successful in completing the task without help. The average completion time was 13.6 seconds.

Participants	Success/Unsuccess	With/Without help	Time (sec)	Interruption for solution by himself, by help	Times of interruption
P1	S	without	20		0
P3	S	without	4		0

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P4	U	with	37		0
P5	S	without	3		0
P6	S	without	4		0

Table 54: Second task from TIGER PRINTS (The solar system)

Four out of 5 participants answered correctly to both comprehension questions, while P3 answered both wronly. The questions were:

Q1: Which is the fifth planet?

Q2: On which orbit is the comet located?

Participants	Question 1	Question 2
P1	Correct	Correct
P3	Wrong	Wrong
P4	Correct	Correct
P5	Correct	Correct
P6	Correct	Correct

Table 55. Comprehension questions (The solar system)

Image 2- The Empire of Alexander the Great

Table 56 presents data from the task “Locate the city of Babylon”. All of the five participants were successful in completing the task. The average completion time was 62.8 seconds.

Participants	Success/Unsuccess	With/Without help	Time (sec)	Interruption for solution by himself, by help	Times of interruption
P1	S	without	46		0
P3	S	with	69	both	2
P4	S	without	55		0
P5	S	without	74		0

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P6	S	with	70		0

Table 56. Task from TIGER PRINTS (The Empire of Alexander the Great)

Three out of five participants answered correctly to the first question and all five participants answered the second question correctly. The questions were:

Q1: In which direction did Alexander the Great's army move when it started from Macedonia?

Q2: Where on the map is Persia located?

Participants	Question 1	Question 2
P1	Correct	Correct
P3	Wrong	Correct
P4	Correct	Correct
P5	Correct	Correct
P6	Wrong	Correct

Table 57. Comprehension questions (The Empire of Alexander the Great)

Image 3-Earth's magnetic field

Table 58 presents data from task 1 (Locate the equator). Three out of 5 participants were successful in completing the task without help. The average completion time was 65.6 seconds.

Participants	Success/Unsuccess	With/Without help	Time (sec)	Interruption for solution by himself, by help	Times of interruption
P1	S	without	18		0
P3	U	without	9		0
P4	U	with	295		0
P5	S	without	2		0
P6	S	without	4		0

Table 58. First task from TIGER PRINTS (Earth's magnetic field)

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Table 59 presents data from task 2 (Locate the magnetic north.). Two out of five participants were successful in completing the task. The average completion time was 36 seconds.

Participants	Success/Unsuccess	With/Without help	Time (sec)	Interruption for solution by himself, by help	Times of interruption
P1	U	without	44	help	1
P3	S	with	39	help	1
P4	U	with	82		0
P5	S	without	12		0
P6	U	without	3		0

Table 59. Second task from TIGER PRINTS (Earth's magnetic field)

Four out of 5 participants answered both questions correctly while P1 answered them both wrongly. The questions were:

Q1: What does the center of the circle represent?

Q2: What direction do the curved lines representing the forces of the field have?

Participants	Question 1	Question 2
P1	Wrong	Wrong
P3	Correct	Correct
P4	Correct	Correct
P5	Correct	Correct
P6	Correct	Correct

Table 60. Comprehension questions (Earth's magnetic field)

Image 4- Bar graph presenting the birthdays of students in a class by month

Table 61 presents data from task 1 (Locate the month of July on the horizontal axis). All five participants were successful in completing the task with one receiving help. The average completion time was 28.6 seconds.

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Participants	Success/Unsuccess	With/Without help	Time (sec)	Interruption for solution by himself, by help	Times of interruption
P1	S	without	5		0
P3	S	without	30		0
P4	S	with	69		0
P5	S	without	12		0
P6	S	without	27		0

Table 61. First task from TIGER PRINTS (Bar graph presenting the birthdays of students)

Table 62 presents data from task 2 (Identify the highest number on the vertical axis). Three out of the five participants were successful in completing the task. The average completion time was 15 seconds.

Participants	Success/Unsuccess	With/Without help	Time (sec)	Interruption for solution by himself, by help	Times of interruption
P1	S	without	9		0
P3	U	with	35		0
P4	U	without	6		0
P5	S	without	21		0
P6	S	without	6		0

Table 62. Second task from TIGER PRINTS (Bar graph presenting the birthdays of students)

All participants answered the first question correctly and four out of 5 participants answered the second question correctly. The questions were:

Q1: Which month has the most students' birthdays?

Q2: How many students have birthdays in March?

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Participants	Question 1	Question 2
P1	Correct	Correct
P3	Correct	Correct
P4	Correct	Correct
P5	Correct	Correct
P6	Correct	Wrong

Table 63. Comprehension questions (Bar graph presenting the birthdays of students)

Image 5- Flowchart depicting the process of dealing with a non-working light bulb

Table 64 presents data from task 1 (Locate the rectangle indicating the start of the process.). All of five participants were successful in completing the task. The average completion time was 6 seconds.

Participants	Success/Unsuccess	With/Without help	Time (sec)	Interruption for solution by himself, by help	Times of interruption
P1	S	with	15	help	2
P3	S	without	5		0
P4	S	without	8		0
P5	S	without	1		0
P6	S	without	2		0

Table 64. First task from TIGER PRINTS (Flowchart depicting the process of dealing with a non-working light bulb)

Table 65 presents data from task 2 (Identify the arrows with the answer "no"). Four out of five participants were successful in completing the task without help. The average completion time was 32 seconds.

Participants	Success/Unsuccess	With/Without help	Time (sec)	Interruption for solution by himself, by help	Times of interruption

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P1	S	without	28	himself	1
P3	U	without	33		0
P4	S	without	72		0
P5	S	without	18		0
P6	S	without	10		0

Table 65. Second task from TIGER PRINTS (Flowchart depicting the process of dealing with a non-working light bulb)

Two out of 5 participants answered the first question correctly and four out of 5 answered the second one correctly. The questions were:

Q1: How does the process start?

Q2: What should you do if the bulb is not burnt out?

Participants	Question 1	Question 2
P1	Wrong	Wrong
P3	Wrong	Correct
P4	Wrong	Correct
P5	Correct	Correct
P6	Correct	Correct

Table 66. Comprehension questions (Flowchart depicting the process of dealing with a non-working light bulb)

Image 6-Stacked bar chart presenting the preferred sports in a 6th grade class

Table 67 presents data from task 1 (Locate tennis on the horizontal axis). Four out of the five participants were successful in completing the task. The average completion time was 9.6 seconds.

Participants	Success/Unsuccess	With/Without help	Time (sec)	Interruption for solution by himself, by help	Times of interruption
P1	S	with	10		0

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P3	S	without	5		0
P4	U	without	18		0
P5	S	without	10		0
P6	S	without	5		0

Table 67. First task from TIGER PRINTS (Stacked bar chart presenting the preferred sports in a 6th grade class)

Table 68 presents data from task 2 (Locate the section of the bar representing girls who like tennis). Four out of the five participants were successful in completing the task without help. The average completion time was 23 seconds.

Participants	Success/Unsuccess	With/Without help	Time (sec)	Interruption for solution by himself, by help	Times of interruption
P1	S	without	6		0
P3	S	without	4		0
P4	U	with	97		0
P5	S	without	5		0
P6	S	without	4		0

Table 68. Second task from TIGER PRINTS (Stacked bar chart presenting the preferred sports in a 6th grade class)

All participants answered both questions correctly. The questions were:

Q1: Which sport do boys prefer more?

Q2: How many students prefer tennis?

Participants	Question 1	Question 2
P1	Correct	Correct
P3	Correct	Correct
P4	Correct	Correct

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P5	Correct	Correct
P6	Correct	Correct

Table 69. Comprehension questions (Stacked bar chart presenting the preferred sports in a 6th grade class)

Image 7- Line chart presenting the food sold per day

Table 70 presents data from task 1 (Locate the horizontal axis). All of the five participants were successful in completing the task. The average completion time was 25.6 seconds.

Participants	Success/Unsuccess	With/Without help	Time (sec)	Interruption for solution by himself, by help	Times of interruption
P1	S	with	16	help	5
P3	S	without	33	himself	2
P4	S	with	75		0
P5	S	without	3		0
P6	S	without	1		0

Table 70. First task from TIGER PRINTS (Line chart presenting the food sold per day)

Table 71 presents data from task 2 (Locate the line representing hot dogs). Two out of five participants were successful in completing the task. The average completion time was 30.6 seconds.

Participants	Success/Unsuccess	With/Without help	Time (sec)	Interruption for solution by himself, by help	Times of interruption
P1	U	with	14	help	2
P3	U	without	6		0
P4	S	with	71		0
P5	U	without	19		0

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P6	S	with	43	help	1

Table 71. Second task from TIGER PRINTS (Line chart presenting the food sold per day)

Three out of five participants answered the first question correctly and four out of five answered the second one correctly. The questions were:

Q1: On which days do the sales increase?

Q2: How many hot dogs were sold on Wednesday?

Participants	Question 1	Question 2
P1	Wrong	Correct
P3	Correct	Correct
P4	Correct	Wrong
P5	Correct	Correct
P6	Wrong	Correct

Table 72. Comprehension questions (Line chart presenting the food sold per day)

Semi-structured interview

The answers in the five questions are presented below.

1. We would like you to make a general comment on the material. How do you evaluate it (positive / negative)?

- Three participants evaluated the material positively and two moderately.

2. What would you keep and what would you change about it? How (in which way) would you change each item you suggest for a change? Can you suggest some changes and improvements?

Participants would generally keep the designs, but make changes to the material:

- Make the Braille letters clearer (one suggested using a traditional Braille printer).
- Make the differences in the thickness of the lines more intense.
- One participant would like for the dots to be less coarse (found them unpleasant).

3. Could you obtain the information/ knowledge provided by this material in another way? e.g., using some or a combination of some other alternative forms of educational material? What are they? (Should be listed individually or in combination).

- **Alternative format**: Tiger embossed prints, audio-tactile material, alternative text, verbal description, magnifier tools for low vision.

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4. Where do you think this material would be helpful for you during your university studies (in which tasks / activities)?

- Supplementary material in seminars
- Courses with diagrams or maps or musical notes (ex. STEM, History, Anatomy)
- Academic tasks and essays

5. What are the advantages and disadvantages of this form of material?

Based on the participants' responses, we can group the advantages and disadvantages of the material into the following themes:

Advantages:

- Helpful
- Easy to carry with you
- Enables creation of mental picture of a design

Disadvantages:

- Braille was not clear
- Dot quality is affected by wear
- Indistinguishable where lines meet each other (for complex images)

Participants noted that they preffered the tactile microcapsule material, mainly because they found the Braille letters to be clearer in that form.

Usability Questionnaire

1. How accessible is the material? - The average response is 6.2 out of 10, indicating that the participants found the material to be barely accessible.
2. How difficult was it for you to use it? - The average response is 6.2 out of 10, indicating that the participants found the material rather difficult to use.
3. To what extent is training required to be able to use it? - The average response is 5.6 out of 10, indicating that the participants felt that some level of training may be required to use the material.
4. Would you use it if it was available to you? - The average response is 5.6 out of 10, indicating that the participants were not very likely to use the material if it were available to them.
5. Would you recommend others to use it? - The average response is 7.2 out of 10, indicating that the participants would possibly recommend others to use the material.
6. To what extent do you believe it will fill gaps of your existent knowledge? - The average response is 6.8 out of 10, indicating that the participants believe that the material only fills some gaps in their knowledge.
7. Could you obtain the information/knowledge provided by this material in another way? - The average response is 8 out of 10, indicating that the participants believed they could obtain the same information elsewhere.
8. Do you think that the material successfully meets the purpose for which it was built? - The average response is 6.6 out of 10, indicating that the participants felt that the material barely met its intended purpose above threshold.
9. How useful would this material be for your university studies? - The average response is 7 out of 10, indicating that the participants believe the material is somewhat useful for their university studies.

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10. How tedious is the material? - The average response is 5.8 out of 10, indicating that participants thought the material could be tedious.
11. How complex and complicated is the material? - The average response is 6.2 out of 10, indicating that the participants found the material a little complex or complicated.
12. How much load (memory and attention) does the material's use require? - The average response is 6.2 out of 10, indicating that the participants believe that the material requires a load of memory and attention.
13. How satisfied are you with the use of this material? - The average response is 5.6 out of 10, indicating that the participants were barely satisfied with the use of the material.

Audio-tactile

Scenarios

The solar system

Table 73 presents data from task 1 (Locate Mars). All six participants were successful in completing the task, five of them without help. The average completion time was 18.5 seconds.

Participants	Success/Unsuccess	With/Without help	Time (sec)	Interruption for solution by himself, by help	Times of interruption
P1	S	without	9		0
P3	S	without	18	help	1
P4	S	without	2		0
P5	S	without	5		0
P6	S	without	17	himself	1
P7	S	with	60	help	1

Table 73. First task from AUDIO-TACTILE (The solar system)

Table 74 presents data from task 2 (Locate the rays of the sun). All six participants were successful in completing the task. The average completion time was 10.6 seconds.

Participants	Success/Unsuccess	With/Without help	Time (sec)	Interruption for solution by himself,	Times of interruption

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				by help	
P1	S	with	9	help	1
P3	S	without	17	help	1
P4	S	with	9	help	1
P5	S	without	9		0
P6	S	with	12		0
P7	S	without	8		0

Table 74: Second task from AUDIO-TACTILE (The solar system)

Four out of 6 participants answered both questions correctly. P1 and P3 answered the first wrongly while P3 and P5 answered the second wrongly. The questions were:

Q1: Which is the fifth planet?

Q2: On which orbit is the comet located?

Participants	Question 1	Question 2
P1	Wrong	Correct
P3	Wrong	Wrong
P4	Correct	Correct
P5	Correct	Wrong
P6	Correct	Correct
P7	Correct	Correct

Table 75. Comprehension questions (The solar system)

Earth's magnetic field

Table 76 presents data from task 1 (Locate the equator). Five out of 6 participants were successful in completing the task, most of them without help. The average completion time was 34.8 seconds.

Participants	Success/Unsuccess	With/Without help	Time (sec)	Interruption for solution by himself, by help	Times of interruption

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P1	S	with	121	help	1
P3	S	without	14	himself	1
P4	S	without	8		0
P5	S	without	2		0
P6	U	without	47		0
P7	S	without	17		0

Table 76. First task from AUDIO-TACTILE (Earth's magnetic field)

Table 77 presents data from task 2 (Locate the magnetic north). Five out of six participants were successful in completing the task. The average completion time was 77.6 seconds.

Participants	Success/Unsuccess	With/Without help	Time (sec)	Interruption for solution by himself, by help	Times of interruption
P1	S	without	13		0
P3	S	with	139	help	3
P4	S	with	166	help	2
P5	U	without	90	herself	1
P6	S	without	13		0
P7	S	without	45		0

Table 77. Second task from AUDIO-TACTILE (Earth's magnetic field)

Five out of 6 participants answered the first question correctly and three out of 6 participants answered the second question correctly. The questions were:

Q1: What does the center of the circle represent?

Q2: What direction do the curved lines representing the forces of the field have?

Participants	Question 1	Question 2

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P1	Correct	Wrong
P3	Correct	Correct
P4	Correct	Correct
P5	Correct	Correct
P6	Correct	Wrong
P7	Wrong	Wrong

Table 78. Comprehension questions (Earth's magnetic field)

Bar graph presenting the birthdays of students in a class by month

Table 79 presents data from task 1 (Locate the month of July on the horizontal axis). All six participants were successful in completing the task. The average completion time was 16 seconds.

Participants	Success/Unsuccess	With/Without help	Time (sec)	Interruption for solution by himself, by help	Times of interruption
P1	S	with	10	both	2
P3	S	with	24		0
P4	S	without	2		0
P5	S	without	39	help	1
P6	S	without	22		0
P7	S	without	1		0

Table 79. First task from AUDIO-TACTILE (Bar graph presenting the birthdays of students)

Table 80 presents data from task 2 (Identify the highest number on the vertical axis). Five out of six participants were successful in completing the task. The average completion time was 57 seconds.

Participants	Success/Unsuccess	With/Without help	Time (sec)	Interruption for solution by himself, by help	Times of interruption
P1	S	with	111	help	1

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P3	S	with	32	help	1
P4	S	without	25		0
P5	U	with	66		0
P6	S	with	35		0
P7	S	without	74	help	1

Table 80. Second task from AUDIO-TACTILE (Bar graph presenting the birthdays of students)

Five out of six participants answered both questions correctly with P3 answering wrongly to Q1 and P4 answering wrongly to Q2. The questions were:

Q1: Which month has the most students' birthdays?

Q2: How many students have birthdays in March?

Participants	Question 1	Question 2
P1	Correct	Correct
P3	Wrong	Correct
P4	Correct	Wrong
P5	Correct	Correct
P6	Correct	Correct
P7	Correct	Correct

Table 81. Comprehension questions (Bar graph presenting the birthdays of students)

Flowchart depicting the process of dealing with a non-working light bulb

Table 82 presents data from task 1 (Locate the rectangle indicating the start of the process.). All of six participants were successful in completing the task. The average completion time was 10.6 seconds.

Participants	Success/Unsuccess	With/Without help	Time (sec)	Interruption for solution by himself, by help	Times of interruption
P1	S	without	4		0
P3	S	with	24	help	2

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P4	S	with	12		0
P5	S	without	5		0
P6	S	without	6		0
P7	S	without	13		0

Table 82. First task from AUDIO-TACTILE (Flowchart depicting the process of dealing with a non-working light bulb)

Table 83 presents data from task 2 (Identify the arrows with the answer "no"). Four out of 6 participants were successful in completing the task. The average completion time was 97.8 seconds.

Participants	Success/Unsuccess	With/Without help	Time (sec)	Interruption for solution by himself, by help	Times of interruption
P1	S	with	127	himself	2
P3	U	with	194	help	2
P4	S	without	72		0
P5	S	without	55		0
P6	U	without	33		0
P7	S	without	106		0

Table 83. Second task from AUDIO-TACTILE (Flowchart depicting the process of dealing with a non-working light bulb)

Six out of 7 participants answered the first question correctly (except P3) and four out of 7 answered the second question correctly (except P1, P3 and P6). The questions were:

Q1: How does the process start?

Q2: What should you do if the bulb is not burnt out?

Participants	Question 1	Question 2
P1	Correct	Wrong
P2	Correct	Correct

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P3	Wrong	Wrong
P4	Correct	Correct
P5	Correct	Correct
P6	Correct	Wrong
P7	Correct	Correct

Table 84. Comprehension questions (Flowchart depicting the process of dealing with a non-working light bulb)

Stacked bar chart presenting the preferred sports in a 6th grade class

Table 85 presents data from task 1 (Locate tennis on the horizontal axis). All six participants were successful in completing the task, most without help. The average completion time was 30.6 seconds.

Participants	Success/Unsuccess	With/Without help	Time (sec)	Interruption for solution by himself, by help	Times of interruption
P1	S	without	7		0
P3	S	without	9		0
P4	S	without	33		0
P5	S	without	3		0
P6	S	without	34		0
P7	S	with	98	help	1

Table 85. First task from AUDIO-TACTILE (Stacked bar chart presenting the preferred sports in a 6th grade class)

Table 86 presents data from task 2 (Locate the section of the bar representing girls who like tennis). All six participants were successful in completing the task without help. The average completion time was 5 seconds.

Participants	Success/Unsuccess	With/Without help	Time (sec)	Interruption for solution by himself,	Times of interruption

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				by help	
P1	S	without	2		0
P3	S	without	9		0
P4	S	without	4		0
P5	S	without	2		0
P6	S	without	5		0
P7	S	without	10		0

Table 86. Second task from AUDIO-TACTILE (Stacked bar chart presenting the preferred sports in a 6th grade class)

All six participants answered both questions correctly. The questions were:

Q1: Which sport do boys prefer more?

Q2: How many students prefer tennis?

Participants	Question 1	Question 2
P1	Correct	Correct
P3	Correct	Correct
P4	Correct	Correct
P5	Correct	Correct
P6	Correct	Correct
P7	Correct	Correct

Table 87. Comprehension questions (Stacked bar chart presenting the preferred sports in a 6th grade class)

Line chart presenting the food sold per day

Table 88 presents data from task 1 (Locate the horizontal axis). Three participants were successful in completing the task without help. The average completion time was 12.6 seconds.

Participants	Success/Unsuccess	With/Without help	Time (sec)	Interruption for solution by himself,	Times of interruption

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				by help	
P1	n/a				
P3	n/a				
P4	n/a				
P5	S	without	12		0
P6	S	without	9		0
P7	S	without	17		0

Table 88. First task from AUDIO-TACTILE (Line chart presenting the food sold per day)

Table 89 presents data from task 2 (Locate the line representing hot dogs). Two participants were successful in completing the task without help. The average completion time was 51.6 seconds.

Participants	Success/Unsuccess	With/Without help	Time (sec)	Interruption for solution by himself, by help	Times of interruption
P1	n/a				
P3	n/a				
P4	n/a				
P5	S	without	45		0
P6	U	without	85	help	1
P7	S	without	25		0

Table 89. Second task from AUDIO-TACTILE (Line chart presenting the food sold per day)

Two participants answered the first question correctly while one participant answered the second question correctly. The questions were:

Q1: On which days do the sales increase?

Q2: How many hot dogs were sold on Wednesday?

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Participants	Question 1	Question 2
P1	n/a	n/a
P3	n/a	n/a
P4	n/a	n/a
P5	Correct	Wrong
P6	Wrong	Correct
P7	Correct	Wrong

Table 90. Comprehension questions (Line chart presenting the food sold per day)

Semi-structured interview

The answers in the five questions are presented below.

1. We would like you to make a general comment on the material. How do you evaluate it (positive / negative)?

- All participants evaluated the material positively.

2. What would you keep and what would you change about it? How (in which way) would you change each item you suggest for a change? Can you suggest some changes and improvements?

- **Most participants would not change anything.** One participant noted that the audio helps people who are not familiar with shapes understand them. Another participant noted that they think every university or scholl should have material like this available.
- **Two participants would generally keep the material the same but suggested minor changes**. One would like the rhythm of voice to change with every shape as to be another factor to help them distinguish the shapes and for the touchpad to be more sensitive. Another would like the shapes to be more distinguishable (they would change the thickness of the lines or the layout).

3. Could you obtain the information/ knowledge provided by this material in another way? e.g., using some or a combination of some other alternative forms of educational material? What are they? (Should be listed individually or in combination).

- **Alternative format**: Tactile material, audio / verbal description, with magnifying tools. One participant suggested physical objects but doubted their effectiveness himself.

4. Where do you think this material would be helpful for you during your university studies (in which tasks / activities)?

- Supplementary material (studying, lectures, exams)
- Courses with diagrams or maps (ex. STEM, History)
- Lab work
- Studying

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- Academic tasks

One participant noted that this material would make university studies easier for them in general. It would enable them to study.

5. What are the advantages and disadvantages of this form of material?

Based on the participants' responses, we can group the advantages and disadvantages of the material into the following themes:

Advantages:

- Understandable (information and shape)
- Makes learning easy.
- Gives access to visual information.
- Clear voice.
- Condensed information.
- Instant access to visual information.
- Helps you understand abstract concepts.

Disadvantages:

- Need for equipment
- Cost
- Need for assistance (you need someone to prepare the material and possibly fit it and calibrate it to the tablet for you)
- Difficult to carry the IVEO tablet / have a personal one / demands space.
- IVEO lags sometimes.

Usability Questionnaire

1. How accessible is the material? - The average response is 9.4 out of 10, indicating that the participants found the material to be very accessible.
2. How difficult was it for you to use it? - The average response is 2 out of 10, indicating that the participants found the material easy to use.
3. To what extent is training required to be able to use it? - The average response is 2.4 out of 10, indicating that the participants felt that little level of training is required to use the material.
4. Would you use it if it was available to you? - The average response is 9.2 out of 10, indicating that the participants would use the material if it were available to them.
5. Would you recommend others to use it? - The average response is 9.1 out of 10, indicating that the participants would very likely recommend others to use the material.
6. To what extent do you believe it will fill gaps of your existent knowledge? - The average response is 9 out of 10, indicating that the participants surely believe that the material fills gaps in their knowledge.
7. Could you obtain the information/knowledge provided by this material in another way? - The average response is 5.8 out of 10, indicating that the participants were ambivalent about obtaining the same information elsewhere.
8. Do you think that the material successfully meets the purpose for which it was built? - The average response is 8.7 out of 10, indicating that the participants felt that the material meets its intended purpose.

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9. How useful would this material be for your university studies? - The average response is 9.2 out of 10, indicating that the participants believe the material is useful for their university studies.
10. How tedious is the material? - The average response is 1.5 out of 10, indicating that participants did not find it tedious.
11. How complex and complicated is the material? - The average response is 2.1 out of 10, indicating that the participants did not find the material very complex or complicated.
12. How much load (memory and attention) does the material's use require? - The average response is 4.5 out of 10, indicating that the participants believe that the material requires a significant a little memory and attention.
13. How satisfied are you with the use of this material? - The average response is 9.2 out of 10, indicating that the participants were satisfied with the use of the material.

Video

Comprehension questions

Comprehension questions were asked to the research participants (P1 – P11), after watching the video. Six participants out of 11 answered Q1: "What is the road full of at the beginning of the video??" correctly. The majority of participants, nine out of 11, answered Q2: "What is the cyclist wearing?" correctly.

Semi-structured interview

The semi-structured interview consisted of 5 questions, which are listed below along with the participants' answers.

1. We would like you to make a general comment on the material. How do you evaluate it (positive / negative)?

- The majority of participants, ten out of 11, evaluated the material positively. Some further commented on finding the material useful and informative, with clear detailed descriptions and helpful visuals. One participant evaluated it negatively.

2. What would you keep and what would you change about it? How (in which way) would you change each item you suggest for a change? Can you suggest some changes and improvements?

- **Audio description to the video:** Three participants suggested major changes to the material. For example, they suggested adding an audio description to the video and so, removing the accompanying Word file.
- **Content of audio description.** Other participants would keep the material but suggested minor changes. Background noises were intergrated to the description given to the participants. However, since these noises and words were not particularly discernable when casually listening to the video, one participant found them confusing. Another participant would remove any information on camera movements (zoom-ins). Another participant would like more emphasis on colors.

3. Could you obtain the information/ knowledge provided by this material in another way? e.g., using some or a combination of some other alternative forms of educational material? What are they? (Should be listed individually or in combination).

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- Four participants did not know or did not mention any alternative formats.
- **Alternative format**: Some participants suggested audio description, three suggested Braille, two suggested assistance of a companion though it would be less advantageous as you can listen to a description whenever you want but you don't always have a companion and one suggested AI.

4. Where do you think this material would be helpful for you during your university studies (in which tasks / activities)?

- Studying
- Doing research
- Academic tasks
- Presentations of projects
- Lectures

Most participants found the material helpful in the context of lectures or presentations where a lot of videos are shown.

5. What are the advantages and disadvantages of this form of material?

Based on the participants' responses, we can group the advantages and disadvantages of the material into the following themes:

Advantages:

- Assists the creation of mental pictures.
- Informative.
- Accessible.
- Interactive.
- Detailed.
- Easy to understand.
- The natural voice of the video makes it less tiring.

Disadvantages:

- Tiring
- The text / description was too long.
- Disrupts the flow of the video. (Some participants found that the accompanying file disrupts the flow of the video as you have to make the connection between the video you heard and what you then hear described yourself.)
- Not readily available to them.
- Difficult to make.

Usability Questionnaire

1. How accessible is the material? - The average response is 9.5 out of 10, indicating that the participants found the material to be highly accessible.
2. How difficult was it for you to use it? - The average response is 0.9 out of 10, indicating that the participants did not find the material difficult at all to use.
3. To what extent is training required to be able to use it? - The average response is 1.8 out of 5, indicating that the participants felt that a little training may be required to use the material.

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4. Would you use it if it was available to you? - The average response is 9.4 out of 10, indicating that the participants would definitely use the material if it were available to them.
5. Would you recommend others to use it? - The average response is 9.6 out of 10, indicating that the participants would definitely recommend others to use the material.
6. To what extent do you believe it will fill gaps of your existent knowledge? - The average response is 8.3 out of 10, indicating that the participants believe the material fills gaps in their knowledge.
7. Could you obtain the information/knowledge provided by this material in another way? - The average response is 6.4 out of 10, indicating that the participants were ambivalent about obtaining the information elsewhere, but thought they probably could.
8. Do you think that the material successfully meets the purpose for which it was built? - The average response is 9.4 out of 10, indicating that the participants felt that the material meets its intended purpose.
9. How useful would this material be for your university studies? - The average response is 9 out of 10, indicating that the participants believed the material would be useful for their university studies.
10. How tedious is the material? - The average response is 2 out of 10, indicating that the participants did not find the material tedious.
11. How complex and complicated is the material? - The average response is 3.2 out of 10, indicating that the participants did not find the material very complex and complicated.
12. How much load (memory and attention) does the material's use require? - The average response is 4.4 out of 10, indicating that the participants thought the material requires a little memory and attention.
13. How satisfied are you with the use of this material? - The average response is 9 out of 10, indicating that the participants were satisfied with the use of the material.

Chem

P1-P11 except P2 (low vision) completed tasks using the "Chem" material.

Chem with MathML

Scenarios

In the first task (Listen to chemical equation 1 and repeat what you heard) four participants were successful and four were not.

Participants	Success/Unsuccess	With/Without help	Time (sec)	Interruption for solution by himself, by help	Times of interruption
P1	n/a				
P3	U	with	72		0

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P4	n/a				
P5	U	without	129		0
P6	S	without	75	himself	1
P7	U	without	220		
P8	S	with	-		1
P9	S	with	2		0
P10	S	without	2		0
P11	U	without	-		0

Table 91. First task from CHEM with MathML

In the second task (Listen to chemical equation 2 and repeat what you heard), three participants were successful and five were not.

Participants	Success/Unsuccess	With/Without help	Time (sec)	Interruption for solution by himself, by help	Times of interruption
P1	n/a				
P3	S	without	28		0
P4	n/a				
P5	U	with	232	herself	1
P6	S	with	190	both	3
P7	U	without	141		
P8	U	with	-		0
P9	U	with	-		0
P10	S	without	2		1
P11	U	without	-		0

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Table 92. Second task from CHEM with MathML

In the third task (Listen to chemical equation 3 and repeat what you heard), one participant was successful.

Participants	Success/Unsuccess	With/Without help	Time (sec)	Interruption for solution by himself, by help	Times of interruption
P1	n/a				
P3	U	with	123		0
P4	n/a				
P5	U	without	112		0
P6	U	without	134		0
P7	U	without	90		
P8	U	with	-		1
P9	U	with	-		0
P10	S	without	2		0
P11	U	without	-		0

Table 93. Third task from CHEM with MathML

In the fourth task (Listen to chemical equation 4 and repeat what you heard), three participants were successful and five were not.

Participants	Success/Unsuccess	With/Without help	Time (sec)	Interruption for solution by himself, by help	Times of interruption
P1	n/a				
P3	S	without	53	help	1

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P4	n/a				
P5	U	with	37	help	1
P6	S	with	58	himself	1
P7	S	without	25	help	
P8	U	with	-		0
P9	U	with	-		1
P10	U	with	-		0
P11	U	without	-		0

Table 94. Fourth task from CHEM with MathML

In the fifth task (Listen to chemical equation 5 and repeat what you heard), five participants were successful and three were not.

Participants	Success/Unsuccess	With/Without help	Time (sec)	Interruption for solution by himself, by help	Times of interruption
P1	n/a				
P3	S	without	30		0
P4	n/a				
P5	S	without	48		0
P6	S	without	41		0
P7	S	with	61		0
P8	U	with	-		0
P9	U	with	-		0
P10	S	without	3		0
P11	U	without	-		0

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Table 95. Fifth task from CHEM with MathML

Semi-structured interview

1. We would like you to make a general comment on the material. How do you evaluate it (positive / negative)?

- Three participants evaluated the material positively and five nagatively.

2. What would you keep and what would you change about it? How (in which way) would you change each item you suggest for a change? Can you suggest some changes and improvements?

- **Suggested changes**:
- The equations were too long and difficult to retain. Some would like to be able to listen to them symbol by symbol. Another participant suggested being able to hear to the first part (reactants) and second part (products) of the equation separately.
- Some synthetic voices did not read every symbol clearly.

One participant thought the program was not meant to read chemical equations.

3. Could you obtain the information/ knowledge provided by this material in another way? e.g., using some or a combination of some other alternative forms of educational material? What are they? (Should be listed individually or in combination).

- **Alternative format**: The participants suggested Braille or the Nemeth code. Other suggestions were Piaf, verbal description, tiger prints, tactile material, magnifying tools / screen magnifier, AI.

4. Where do you think this material would be helpful for you during your university studies (in which tasks / activities)?

- STEM courses
- Academic tasks / assignments
- Studying

5. What are the advantages and disadvantages of this form of material?

Based on the participants' responses, we can group the advantages and disadvantages of the material into the following themes:

Advantages:

- Accessible
- Symbols are read as someone would see them
- Understandable

Disadvantages:

- Tiring
- Fast paced
- Some symbols were not read clearly / correctly
- Inability to be read symbol by symbol

Usability Questionnaire

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The questionnaire was completed by both participants.

1. How accessible is the material? – The average response was 4.1 out of 10 showing the material was not considered accessible enough.
2. How difficult was it for you to use it? - The average response was 4.7 out of 10.
3. To what extent is training required to be able to use it? - The average response was 4.3 out of 10
4. Would you use it if it was available to you? - The average response was 4.6 out of 10.
5. Would you recommend others to use it? - The average response was 4.6 out of 10.
6. To what extent do you believe it will fill gaps of your existent knowledge? - The average response was 4.1 out of 10.
7. Could you obtain the information/knowledge provided by this material in another way? – The average response was 9 out of 10 showing that participants believed they could obtain the same information in other ways.
8. Do you think that the material successfully meets the purpose for which it was built? - The average response was 3.8 out of 10.
9. How useful would this material be for your university studies? - The average response was 4.6 out of 10.
10. How tedious is the material? The average response was 5.2 out of 10.
11. How complex and complicated is the material? - The average response was 4.6 out of 10.
12. How much load (memory and attention) does the material's use require? - The average response was 6.7 out of 10 showing the participants believed the material required some memory and/or attention.
13. How satisfied are you with the use of this material? - The average response was 4.2 out of 10.

Chem with Verbal Description

Scenarios

In the first task (Listen to chemical equation 1 and repeat what you heard) seven participants were successful and three were not.

Participants	Success/Unsuccess	With/Without help	Time (sec)	Interruption for solution by himself, by help	Times of interruption
P1	S	without	16		0
P3	S	without	38		0
P4	S	without	30		0
P5	S	without	76	help	2

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ΙΔΡΥΜΑ ΚΡΑΤΙΚΩΝ ΥΠΟΤΡΟΦΙΩΝ IKY

P6	S	without	19		0
P7	S	without	20		0
P8	U	with	-		0
P9	U	with	-		0
P10	S	without	2		0
P11	U	without	-		0

Table 96. First task from CHEM with VD

In the second task (Listen to chemical equation 2 and repeat what you heard), three participants were successful and seven were not.

Participants	Success/Unsuccess	With/Without help	Time (sec)	Interruption for solution by himself, by help	Times of interruption
P1	U	without	45	himself	1
P3	U	with	56		0
P4	S	without	23		
P5	U	with	209	help	1
P6	U	without	57		0
P7	S	without	39		
P8	U	with	-		1
P9	U	with	-		0
P10	S	without	2		0
P11	U	without	-		0

Table 97. Second task from CHEM with VD

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In the third task (Listen to chemical equation 3 and repeat what you heard), six participants were successful and four were not.

Participants	Success/Unsuccess	With/Without help	Time (sec)	Interruption for solution by himself, by help	Times of interruption
P1	S	without	21	himself	1
P3	U	without	49		0
P4	S	without	63		
P5	S	with	58	help	1
P6	S	without	20		0
P7	S	without	29		
P8	U	with	-		0
P9	U	with	-		0
P10	S	without	1		1
P11	U	without	-		0

Table 98. Third task from CHEM with VD

In the fourth task (Listen to chemical equation 4 and repeat what you heard), three participants were successful and seven were not.

Participants	Success/Unsuccess	With/Without help	Time (sec)	Interruption for solution by himself, by help	Times of interruption
P1	U	without	11		0
P3	U	without	27		0
P4	U	without	22		

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ΙΔΡΥΜΑ ΚΡΑΤΙΚΩΝ ΥΠΟΤΡΟΦΙΩΝ IKY

P5	U	without	67		0
P6	S	without	41		0
P7	S	without	12		0
P8	U	with	-		0
P9	U	with	-		0
P10	S	without	3		0
P11	U	without	-		0

Table 99. Fourth task from CHEM with VD

In the fifth task (Listen to chemical equation 5 and repeat what you heard), six participants were successful and four were not.

Participants	Success/Unsuccess	With/Without help	Time (sec)	Interruption for solution by himself, by help	Times of interruption
P1	S	without	18		0
P3	S	without	27		0
P4	S	without	12		0
P5	S	with	174	help	1
P6	S	without	11		0
P7	S	without	14		0
P8	U	with	-		0
P9	U	with	-		0
P10	U	with	-		0
P11	U	without	-		0

Table 100. Fifth task from CHEM with VD

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Semi-structured interview

1. We would like you to make a general comment on the material. How do you evaluate it (positive / negative)?

- Seven participants evaluated the material positively and three nagatively.

2. What would you keep and what would you change about it? How (in which way) would you change each item you suggest for a change? Can you suggest some changes and improvements?

- **Most participants would not make ay changes.**
- **Some participants suggested minor changes**. The synthetic voices did not read everything clearly, so they would experiment with different voices. The voice was too fast for them to retain the information. One participant suggested leaving a blank space between the equations in addition to the numbered list in which they were given.

One participant thought the descriptions were not meant for chemical equations.

3. Could you obtain the information/ knowledge provided by this material in another way? e.g., using some or a combination of some other alternative forms of educational material? What are they? (Should be listed individually or in combination).

- **Alternative format**: The participants suggested Braille or the Nemeth code. Other suggestions were Piaf, tactile material, magnifying tools / screen magnifier, AI.

4. Where do you think this material would be helpful for you during your university studies (in which tasks / activities)?

- STEM courses
- Academic tasks / assignments
- Studying

5. What are the advantages and disadvantages of this form of material?

Based on the participants' responses, we can group the advantages and disadvantages of the material into the following themes:

Advantages:

- Accessible
- Useful
- More understandable than Chem with MathML
- Gives access to chemical equations

Disadvantages:

- Fast paced
- The synthetic voice
- Hard to understand

Usability Questionnaire

The questionnaire was completed by both participants.

1. How accessible is the material? – The average response was 6.7 out of 10 showing the participants were ambivalent but leaning towards rating it as accessible.
2. How difficult was it for you to use it? - The average response was 2.5 out of 10.

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3. To what extent is training required to be able to use it? - The average response was 2.7 out of 10
4. Would you use it if it was available to you? - The average response was 7 out of 10.
5. Would you recommend others to use it? - The average response was 6.5 out of 10.
6. To what extent do you believe it will fill gaps of your existent knowledge? - The average response was 6.2 out of 10.
7. Could you obtain the information/knowledge provided by this material in another way? – The average response was 6.3 out of 10 showing that participants were somewhat ambivalent but thought they were likely to obtain the same information in other ways.
8. Do you think that the material successfully meets the purpose for which it was built? - The average response was 6.5 out of 10.
9. How useful would this material be for your university studies? - The average response was 5.6 out of 10.
10. How tedious is the material? The average response was 3.7 out of 10.
11. How complex and complicated is the material? - The average response was 2.5 out of 10.
12. How much load (memory and attention) does the material's use require? - The average response was 5.3 out of 10 showing the participants believed the material required some memory and/or attention.
13. How satisfied are you with the use of this material? - The average response was 6.7 out of 10.

Math

P1-P11 except P2 (low vision) completed tasks using the "Math" material.

MathML

Scenarios

In the first task (Listen to mathematical equation 1 and repeat what you heard) five participants were successful and three were not.

Participants	Success/Unsuccess	With/Without help	Time (sec)	Interruption for solution by himself, by help	Times of interruption
P1	n/a				
P3	S	without	10	himself	1
P4	n/a				
P5	S	without	3		
P6	S	without	12		0

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P7	U	with	24		0
P8	U	with	-		0
P9	S	with	1		0
P10	S	without	1		1
P11	U	without	-		0

Table 101. First task from MathML

In the second task (Listen to mathematical equation 2 and repeat what you heard), six participants were successful and two were not.

Participants	Success/Unsuccess	With/Without help	Time (sec)	Interruption for solution by himself, by help	Times of interruption
P1	n/a				
P3	S	without	18	himself	1
P4	n/a				
P5	S	without	8		0
P6	S	without	11		0
P7	S	with	34		0
P8	U	with	-		0
P9	S	with	2		0
P10	S	without	1		0
P11	U	without	-		0

Table 102. Second task from MathML

In the third task (Listen to mathematical equation 3 and repeat what you heard), three participants were successful and five were not.

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Participants	Success/Unsuccess	With/Without help	Time (sec)	Interruption for solution by himself, by help	Times of interruption
P1	n/a				
P3	U	without	40	himself	2
P4	n/a				
P5	S	without	32	herself	1
P6	S	without	33		0
P7	U	with	65		0
P8	U	with	-		0
P9	U	with	-		0
P10	S	without	2		0
P11	U	without	-		0

Table 103. Third task from MathML

In the fourth task (Listen to mathematical equation 4 and repeat what you heard), one participant was successful and seven were not.

Participants	Success/Unsuccess	With/Without help	Time (sec)	Interruption for solution by himself, by help	Times of interruption
P1	n/a				
P3	U	with	64		0
P4	n/a				
P5	U	without	77	help	1
P6	U	without	60		0

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ΙΔΡΥΜΑ ΚΡΑΤΙΚΩΝ ΥΠΟΤΡΟΦΙΩΝ IKY

P7	U	without	71		0
P8	U	with	-		0
P9	U	with	-		0
P10	S	without	2		0
P11	U	without	-		0

Table 104. Fourth task from MathML

In the fifth task (Listen to mathematical equation 5 and repeat what you heard), one participant was successful and seven were not.

Participants	Success/Unsuccess	With/Without help	Time (sec)	Interruption for solution by himself, by help	Times of interruption
P1	n/a				
P3	U	without	36		0
P4	n/a				
P5	U	with	48		0
P6	U	with	91	help	1
P7	U	with	121		0
P8	U	with	-		0
P9	U	with	-		0
P10	S	without	2		0
P11	U	without	-		0

Table 105. Fifth task from MathML

Semi-structured interview.

1. We would like you to make a general comment on the material. How do you evaluate it (positive / negative)?

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- Three participants evaluated the material positively, one moderately and four nagatively.

2. What would you keep and what would you change about it? How (in which way) would you change each item you suggest for a change? Can you suggest some changes and improvements?

- **Suggested changes**:
- The equations were difficult to retain. Some would like to be able to listen to them symbol by symbol. Another participant suggested leaving a blank space between the equations to make their disctinction clearer.
- Better diction. Some synthetic voices did not read every symbol clearly in every language. - Problems were observed in both Greek and Spanish. -

3. Could you obtain the information/ knowledge provided by this material in another way? e.g., using some or a combination of some other alternative forms of educational material? What are they? (Should be listed individually or in combination).

- **Alternative format**: The participants suggested Braille. Other suggestions were Piaf, verbal description, tiger prints, tactile material, magnifying tools / screen magnifier, AI.

4. Where do you think this material would be helpful for you during your university studies (in which tasks / activities)?

- STEM courses
- Academic tasks / assignments
- Studying

5. What are the advantages and disadvantages of this form of material?

Based on the participants' responses, we can group the advantages and disadvantages of the material into the following themes:

Advantages:

- Accessible
- Symbols are read as someone would see them

Disadvantages:

- Time consuming
- Some symbols were not read clearly / correctly
- Difficult to understand
- Needs improvements to be fully accessible

According to the participants, most disadvantages were caused by the unclear reading of the symbols.

Usability Questionnaire

The questionnaire was completed by both participants.

1. How accessible is the material? – The average response was 4.75 out of 10 showing the material was not considered accessible enough.
2. How difficult was it for you to use it? - The average response was 4.5 out of 10.
3. To what extent is training required to be able to use it? - The average response was 4.5 out of 10
4. Would you use it if it was available to you? - The average response was 5.2 out of 10.

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5. Would you recommend others to use it? - The average response was 4.7 out of 10.
6. To what extent do you believe it will fill gaps of your existent knowledge? - The average response was 4 out of 10.
7. Could you obtain the information/knowledge provided by this material in another way? – The average response was 8.7 out of 10 showing that participants believed they could obtain the same information in other ways.
8. Do you think that the material successfully meets the purpose for which it was built? - The average response was 4.5 out of 10.
9. How useful would this material be for your university studies? - The average response was 4.8 out of 10.
10. How tedious is the material? The average response was 4.1 out of 10.
11. How complex and complicated is the material? - The average response was 3.7 out of 10.
12. How much load (memory and attention) does the material's use require? - The average response was 4.7 out of 10 showing the participants believed the material required some memory and/or attention.
13. How satisfied are you with the use of this material? - The average response was 4.5 out of 10 showing the participants were not satisfied with the material.

Math with Verbal Description

Scenarios

In the first task (Listen to mathematical equation 1 and repeat what you heard), seven participants were successful and three were not.

Participants	Success/Unsuccess	With/Without help	Time (sec)	Interruption for solution by himself, by help	Times of interruption
P1	S	without	7		0
P3	S	without	6		0
P4	S	without	4		
P5	S	without	3		0
P6	S	without	5		0
P7	S	without	50		0
P8	U	with	-		0
P9	U	with	-		0

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ΙΔΡΥΜΑ ΚΡΑΤΙΚΩΝ ΥΠΟΤΡΟΦΙΩΝ IKY

P10	S	without	1		0
P11	U	without	-		0

Table 106. First task from Math with VD

In the second task (Listen to mathematical equation 2 and repeat what you heard), seven participants were successful and three were not.

Participants	Success/Unsuccess	With/Without help	Time (sec)	Interruption for solution by himself, by help	Times of interruption
P1	S	without	12		0
P3	S	with	16		0
P4	S	without	25		
P5	S	without	9		0
P6	S	without	12		0
P7	S	without	11		0
P8	U	with	-		0
P9	U	with	-		0
P10	S	without	2		0
P11	U	without	-		0

Table 107. Second task from Math with VD

In the third task (Listen to mathematical equation 3 and repeat what you heard), seven participants were successful and three were not.

Participants	Success/Unsuccess	With/Without help	Time (sec)	Interruption for solution by himself, by help	Times of interruption

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ΙΔΡΥΜΑ ΚΡΑΤΙΚΩΝ ΥΠΟΤΡΟΦΙΩΝ IKY

P1	S	without	12		0
P3	S	with	16	help	1
P4	S	without	18		0
P5	S	without	11		0
P6	S	without	18		0
P7	S	without	15		0
P8	U	with	-		0
P9	U	with	-		0
P10	S	without	2		0
P11	U	without	-		0

Table 108. Third task from Math with VD

In the fourth task (Listen to mathematical equation 4 and repeat what you heard), seven participants were successful and three were not.

Participants	Success/Unsuccess	With/Without help	Time (sec)	Interruption for solution by himself, by help	Times of interruption
P1	S	without	7		0
P3	S	without	10		0
P4	S	without	16		0
P5	S	without	17		0
P6	S	without	11		0
P7	S	without	13		0
P8	U	with	-		0
P9	U	with	-		0

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P10	S	without	2		0
P11	U	without	-		0

Table 109. Fourth task from Math with VD

In the fifth task (Listen to mathematical equation 5 and repeat what you heard), five participants were successful and five were not.

Participants	Success/Unsuccess	With/Without help	Time (sec)	Interruption for solution by himself, by help	Times of interruption
P1	S	without	30	himself	1
P3	U	with	48	both	3
P4	S	without	18		
P5	S	with	47	herself	1
P6	U	without	63		0
P7	S	without	32	both	0
P8	U	with	-		0
P9	U	with	-		0
P10	S	without	2		0
P11	U	without	-		0

Table 110. Fifth task from Math with VD

Semi-structured interview

1. We would like you to make a general comment on the material. How do you evaluate it (positive / negative)?

- Seven participants evaluated the material positively and three nagatively.

2. What would you keep and what would you change about it? How (in which way) would you change each item you suggest for a change? Can you suggest some changes and improvements?

- **Most participants would not make ay changes.**

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- **Some participants suggested minor changes**. The synthetic voices did not read everything clearly /t/ or /d/. The voice was too fast for them to retain the information. One participant suggested leaving a blank space between the equations in addition to the numbered list in which they were given.

3. Could you obtain the information/ knowledge provided by this material in another way? e.g., using some or a combination of some other alternative forms of educational material? What are they? (Should be listed individually or in combination).

- **Alternative format**: The participants suggested Braille or printed forms. Other suggestions were Piaf, magnifying tools / screen magnifier, AI.

4. Where do you think this material would be helpful for you during your university studies (in which tasks / activities)?

- STEM courses
- Academic tasks / assignments
- Studying
- Math equations in lecture notes
- Exams

5. What are the advantages and disadvantages of this form of material?

Based on the participants' responses, we can group the advantages and disadvantages of the material into the following themes:

Advantages:

- Helpful
- Instant access
- Makes Math understandable even to someone who is not familiar with Math symbols
- Gives access to Math (which is not usually available)

Disadvantages:

- Fast paced
- The synthetic voice
- Hard to understand
- Tiring
- Gives access to words, not symbols.

Usability Questionnaire

The questionnaire was completed by both participants.

1. How accessible is the material? – The average response was 6.9 out of 10 showing the participants were ambivalent but leaning towards rating it as accessible.
2. How difficult was it for you to use it? - The average response was 2.2 out of 10.
3. To what extent is training required to be able to use it? - The average response was 3.6 out of 10.
4. Would you use it if it was available to you? - The average response was 7 out of 10.
5. Would you recommend others to use it? - The average response was 7.2 out of 10.
6. To what extent do you believe it will fill gaps of your existent knowledge? - The average response was 6.1 out of 10.

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7. Could you obtain the information/knowledge provided by this material in another way? – The average response was 7.2 out of 10 showing that participants believed they were likely to obtain the same information in other ways.
8. Do you think that the material successfully meets the purpose for which it was built? - The average response was 7.2 out of 10.
9. How useful would this material be for your university studies? - The average response was 6.2 out of 10.
10. How tedious is the material? The average response was 1.9 out of 10.
11. How complex and complicated is the material? - The average response was 2.1 out of 10.
12. How much load (memory and attention) does the material's use require? - The average response was 3 out of 10 showing the participants believed the material required a little memory and/or attention.
13. How satisfied are you with the use of this material? - The average response was 7 out of 10.

1.2. Study of Individuals with Mobility Impairments

1.2.1. Participants

The participants of the study [Participant 1 (P1) - Participant 6 (P6)] were 6, of whom 4 were men and two were women. Their mean age was 29 years. Three were from Greece and studied at the University of Macedonia and three were from Spain and studied at the University of Alicante. Four were undergraduate students and two were pursuing a Master's degree. Two studies at the Department of Educational and Social Policy, one at the Department of International Studies, one at the Department of Social and Legal Sciences, one studied Archtecture and one did not specify.

Mobility impairments occurred in their lower and upper extremities (n=5) or one side of their body (n=1). The impairment occurred congenitally for three participants and at the age of 2, 4 and 34 for the other three. Tha cause of the impairment was celebral palsy for two participants, transverse myelitis for one participant, Duchenne muscular dystrophy for one participant, VACTERL syndrome for one participant and one did not specify.

Participants gave the following answers about the functionality of their hands: 1.I handle all objects easily and successfully. I may have some difficulties in activities that require great speed or/and accuracy. However, these difficulties do not restrict my independence in my daily activities at all (n=2). 2. I handle all objects with somewhat reduced quality (accuracy) or/and speed. Certain activities need to be done in alternative ways. Usually, these difficulties do not restrict my independence in my daily activities (n=2). 3. I handle objects with difficulty, I need help to prepare or modify the activities. My performance is slow and can be achieved with limited success regarding the quantity and quality of the activity. I can be independent only if the activities have been adapted for me (n=1). 4. I cannot handle objects as I have a severely limited ability to perform even simple actions. I need total assistance (n=1).

Ragarding their commute, three participants said they moved alone, two said they sometimes moved alone and sometimes with the help of an attendant and one moved with the help of an attendant. One participant never moved alone, three moved alone most of the time and two always.

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Participants agreed with the following answers about their commute: 1. In most places, I walk without any assistance. However, outside my home, I may use either walking aids – walkers, crutch, cane – for walking or climbing up the stairs or a wheelchair for long distances. (n=2). 2. In all cases and all places, I use a wheelchair. At best, I can use an electric wheelchair. I always need special support in my waist, torso, and head. I use many types of assistive devices for mobility impairments, but I still need another person's assistance (n=2). 3. I walk in any place without restrictions and assistance. I may have balance, speed, or motor-coordination difficulties (n=1). One participant felt that none of the provided descriptions fitted their commute.

1.2.2. Instruments

The tools used for the present study are as follows: a) questionnaire for collecting demographic information of the participants, b) scenarios of activities for navigating accessible educational material, c) semi-structured interviews for evaluating the accessible educational material, and d) questionnaire on the usability of the accessible educational material.

1.2.3. Procedure

The same process was followed as with individuals with visual impairments. In particular, the process of the experiment consists of a set of structured steps for collecting data and evaluating accessible educational material. The use of multiple tools such as the semi-structured interview and the usability questionnaire can provide further information on how users interact with the accessible educational material and how useful they consider it to be. The steps were as follows:

- Step 1. Participants answered the demographic questionnaire.
- Step 2. The scenario was implemented for each accessible educational material.
- Step 3. Participants independently explored the accessible educational material, thinking aloud and commenting on its accessibility.
- Step 4. The semi-structured interview was conducted.
- Step 5. The usability questionnaire was completed.

1.2.4. Analysis

During the assessment of accessible educational material, the following variables were used to measure the effectiveness of the educational material in achieving the desired learning outcomes.

- Success/Unsuccess: This variable indicates whether the participant was successful or unsuccessful in completing the scenario.
- With/without help: This variable indicates whether the participant completed the scenario with or without assistance.
- Time: This variable measures the time taken by the participant to complete the scenario.
- Interruption for solution by himself, by help: This variable measures the number of times the participant was interrupted and needed help to find a solution to complete the scenario.
- Times of interruption: This variable measures the total number of interruptions experienced by the participant during the completion of the scenario.

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By collecting and analyzing these variables, researchers and educators can identify areas where participants may be struggling or where the educational material needs improvement to better support learning outcomes.

1.2.5. Results

MS Word – Textbook

Scenarios

Tables 111-112 present the results of an assessment of six participants' completion of tasks involving a Word textbook.

Table 111 shows that five out of 6 participants were successful in completing the task "Find chapter 4 'Responsibility and Choice'". Three of the participants completed the task without any help, while three received help. The average completion time was 87 seconds.

Participants	Success/Unsuccess	With/Without help	Time (sec)	Interruption for solution by himself, by help	Times of interruption
P1	S	with	92		0
P2	U	with	297		0
P3	S	with	67		0
P4	S	without	25	himself	1
P5	S	without	25	himself	0
P6	S	without	18	himself	0

Table 111. First task from MS Word – Textbook

Table 112 displays that all participants were successful in completing the task "Go to page 16". The average completion time was 86.6 seconds.

Participants	Success/Unsuccess	With/Without help	Time (sec)	Interruption for solution by himself, by help	Times of interruption
P1	S	with	84	help	3
P2	S	with	130	help	1

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P3	S	without	20		0
P4	S	without	180	himself	1
P5	S	without	16	himself	0
P6	S	without	90	himself	0

Table 112. Second task from MS Word Textbook

Independent exploration

Participants commented on the ease of navigation, especially compared to other materials some of them had explored before the MS Word textbook. One participant noted that the material was easy while the hardware with which they explored it demanded practice.

Semi-structured interview

The semi-structured interview consisted of 5 questions, which are listed below along with the participants' answers.

1. We would like you to make a general comment on the material. How do you evaluate it (positive / negative)?

- All six participants evaluated the material positively.

2. What would you keep and what would you change about it? How (in which way) would you change each item you suggest for a change? Can you suggest some changes and improvements?

According to the participants' feedback on what to keep and what to change about the material:

- Two participants would not make any changes. Others suggested:
  Keep the Navigation:
  -Format
  -Easy and direct access to specific pages
  Change/Modify the software used (Camera Mouse):
  -Software modifications (double click when blinking).
  -Enable voice commands.
  -Improve stability to software used

3. Could you obtain the information/ knowledge provided by this material in another way? e.g., using some or a combination of some other alternative forms of educational material? What are they? (Should be listed individually or in combination).

- **Alternative forms / options:** PDF, ePub, audio, video, podcast.
- **Alternative ways to access the text:** VoiceCommands, NVDA

4. Where do you think this material would be helpful for you during your university studies (in which tasks / activities)?

- Academic tasks

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- Lecture notes
- Studying
- Literature

5. What are the advantages and disadvantages of this form of material?

Advantages

- The document is well organized.
- The font is big enough.
- Less tiring.
- Fast navigation
- Easy navigation to page icons and chapters
- Camera Mouse is free
- Editable
- Very accessible

Disadvantages

- Camera Mouse moves too fast.
- ICT traing required.
- The navigation bar for pages
- Camera Mouse is slow
- Complex

It must be noted that most of the disadvantages mentioned by the participants do not apply to the material itself, but the software used in the study.

Usability Questionnaire

The questionnaire contained the following questions, for which the participants' answers are reported, and their interpretation is given.

1. How accessible is the material? - The average response is 9.0 out of 10, indicating that the participants found the material to be highly accessible.
2. How difficult was it for you to use it? - The average response is 3.6 out of 10, suggesting that the participants did not find the material overly difficult to use.
3. To what extent is training required to be able to use it? - The average response is 4.8 out of 10, indicating that the participants believed that some training might be beneficial to use the material effectively.
4. Would you use it if it was available to you? - The average response is 7.3 out of 10, indicating a strong inclination among participants to use the material if it were available to them.
5. Would you recommend others to use it? - The average response is 9.3 out of 10, suggesting a high likelihood of participants recommending the material to others.
6. To what extent do you believe it will fill gaps of your existent knowledge? - The average response is 8.5 out of 10, indicating that participants perceived the material to be quite effective in filling knowledge gaps.
7. Could you obtain the information/knowledge provided by this material in another way? - The average response is 5.8 out of 10, suggesting that the participants were ambivalent about alternative ways to acquire the same knowledge.

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8. Do you think that the material successfully meets the purpose for which it was built? - The average response is 7.5 out of 10, indicating that participants viewed the material as relatively fulfilling its intended purpose.
9. How useful would this material be for your university studies? - The average response is 7.3 out of 10, indicating that participants perceived the material as quite useful for their university studies.
10. How tedious is the material? - The average response is 4.6 out of 10, suggesting that participants did not find the material excessively tedious.
11. How complex and complicated is the material? - The average response is 4.3 out of 10, indicating that participants did not perceive the material to be highly complex or complicated.
12. How much load (memory and attention) does the material's use require? - The average response is 5.5 out of 10, suggesting that participants perceived the material to require moderate levels of memory and attention.
13. How satisfied are you with the use of this material? - The average response is 7.1 out of 10, indicating a level of satisfaction with the use of the material among participants.

PDF – Textbook

Scenarios

Tables 113-114 present the results of an assessment of six participants' completion of tasks involving a PDF textbook.

Table 113 shows that all 6 participants were successful in completing the task "Find chapter 4 ‘Responsibility and Choice’", most without help. The average completion time was 65 seconds.

Participants	Success/Unsuccess	With/Without help	Time (sec)	Interruption for solution by himself, by help	Times of interruption
P1	S	with	3		0
P2	S	with	29		0
P3	S	without	88	help	1
P4	S	without	205	help	2
P5	S	without	6	himself	0
P6	S	without	60	himself	0

Table 113. First task from PDF – Textbook

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Table 114 displays that five out of 6 participants were successful in completing the task “Go to page 16”, most without help. The average completion time was 79 seconds.

Participants	Success/Unsuccess	With/Without help	Time (sec)	Interruption for solution by himself, by help	Times of interruption
P1	S	with	273	help	2
P2	U	with	110		0
P3	S	without	59		0
P4	S	without	15	himself	0
P5	S	without	5	himself	0
P6	S	without	13	himself	0

Table 114. Second task from PDF - Textbook

Independent exploration

One participant noted that the material was easy while the hardware with which they explored it demanded practice. Another commented they would like bigger page icons and noted that any new form of hardware used requires ICT training and practice.

The researcher also noted that for one of the participants the alignment of the chapter menu on the right was advantageous for their mobility profile.

Semi-structured interview

The semi-structured interview consisted of 5 questions, which are listed below along with the participants' answers.

1. We would like you to make a general comment on the material. How do you evaluate it (positive / negative)?

- All six participants evaluated the material positively, one of them noted that it was a moderately positive evaluation.

2. What would you keep and what would you change about it? How (in which way) would you change each item you suggest for a change? Can you suggest some changes and improvements?

According to the participants' feedback on what to keep and what to change about the material:

- Two participants would not make any changes. Others suggested:
  Keep:

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-Format of material (one out of two participants that mentioned it also noted that they preferred it compared to other material formats used in the study).
-Navigation with eye movement.

Change/Modify:

-Bigger icons.
-Software (Camera Mouse) sensitivity.
-Software modifications (double click when blinking).
-Enable voice commands.
-Improve stability to software used

3. Could you obtain the information/ knowledge provided by this material in another way? e.g., using some or a combination of some other alternative forms of educational material? What are they? (Should be listed individually or in combination).

- **Alternative forms / options:** MS Word, ePub, audio, video, podcast, PowerPoint.
- **Alternative ways to access the text:** VoiceCommands

4. Where do you think this material would be helpful for you during your university studies (in which tasks / activities)?

- Academic tasks
- Lecture notes
- Studying (would not lose time searching for specific chapters)
- Literature

5. What are the advantages and disadvantages of this form of material?

Advantages

- Navigation to contents / pages
- Comprehensive
- Easier than ePub / DAISY formats

Disadvantages

- Camera Mouse demands concentration so it would be difficult to use in a class.
- The navigation bar for pages
- Not editable

Usability Questionnaire

The questionnaire contained the following questions, for which the participants' answers are reported, and their interpretation is given.

1. How accessible is the material? - The average response is 7.8 out of 10, indicating that the participants found the material to be quite accessible.
2. How difficult was it for you to use it? - The average response is 3.1 out of 10, suggesting that the participants did not find the material overly difficult to use.
3. To what extent is training required to be able to use it? - The average response is 4.6 out of 10, indicating that the participants believed that some training might be beneficial to use the material effectively.

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4. Would you use it if it was available to you? - The average response is 7 out of 10, indicating a strong inclination among participants to use the material if it were available to them.
5. Would you recommend others to use it? - The average response is 9 out of 10, suggesting a high likelihood of participants recommending the material to others.
6. To what extent do you believe it will fill gaps of your existent knowledge? - The average response is 8.3 out of 10, indicating that participants perceived the material to be quite effective in filling knowledge gaps.
7. Could you obtain the information/knowledge provided by this material in another way? - The average response is 7.1 out of 10, suggesting that the participants thought they were likely to acquire the same knowledge in other ways.
8. Do you think that the material successfully meets the purpose for which it was built? - The average response is 8.1 out of 10, indicating that participants viewed the material as fulfilling its intended purpose.
9. How useful would this material be for your university studies? - The average response is 7 out of 10, indicating that participants perceived the material as quite useful for their university studies.
10. How tedious is the material? - The average response is 5.1 out of 10, suggesting that participants found the material a little tedious.
11. How complex and complicated is the material? - The average response is 4.3 out of 10, indicating that participants did not perceive the material to be highly complex or complicated.
12. How much load (memory and attention) does the material's use require? - The average response is 5.8 out of 10, suggesting that participants perceived the material to require moderate levels of memory and attention.
13. How satisfied are you with the use of this material? - The average response is 7.1 out of 10, indicating a level of satisfaction with the use of the material among participants.

DAISY – Textbook

Scenarios

Tables 115-116 represent the results of an assessment of participants' completion of tasks involving a DAISY textbook.

Table 115 shows that five out of 6 participants were successful in completing the task " Find chapter 4 ‘Responsibility and Choice '".

Participants	Success/Unsuccess	With/Without help	Time (sec)	Interruption for solution by himself, by help	Times of interruption
P1	S	with	8	both	3
P2	S	without	19		0
P3	S	without	4		0

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P4	S	-	-		-
P5	S	-	-		-
P6	U	-	-		-

Table 115. First task from DAISY- Textbook

Table 116 displays that two out of 6 participants were successful in completing the task “Go to page 16” without help.

Participants	Success/Unsuccess	With/Without help	Time (sec)	Interruption for solution by himself, by help	Times of interruption
P1	S	without	18		0
P2	U	with	847	both	6
P3	S	without	20		0
P4	U	-	-		-
P5	U	-	-		-
P6	U	-	-		-

Table 116. Second task from DAISY Textbook

Independent exploration

Participants commented on the unfamiliarity of the material and on the fact that it was their first time using it. Nevertheless, one participant commented on finding it good and useful.

Semi-structured interview

The semi-structured interview consisted of 5 questions, which are listed below along with the participants' answers.

1. We would like you to make a general comment on the material. How do you evaluate it (positive / negative)?

- Two participants gave a positive evaluation while one participant gave a negative evaluation. The answers of three participants were not recorded.

2. What would you keep and what would you change about it? How (in which way) would you change each item you suggest for a change? Can you suggest some changes and improvements?

- Two participants would not change anything.
- **Change/Modify:** The navigation to pages and chapters.

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4. Could you obtain the information/ knowledge provided by this material in another way? e.g., using some or a combination of some other alternative forms of educational material? What are they? (Should be listed individually or in combination).

- **Alternative forms:** audiobooks, audio recorded material, MS Word, PowerPoint, PDF, ePub.

5. Where do you think this material would be helpful for you during your university studies (in which tasks / activities)?

- Academic tasks
- Lectures
- Studying
- Exams

However, one participant noted they would not use it for anything as they foud it difficult.

6. What are the advantages and disadvantages of this form of material?

Based on the responses of the participants, the advantages and disadvantages of this form of material are as follows:

Advantages:

- Helpful for disability (especially for VI)
- Instant access to contents when opening the reader.

Disadvantages:

- Position of page locator bar.
- Difficulty in changing pages within the document.

Usability Questionnaire

The questionnaire contained the following questions, for which the participants' answers are reported, and their interpretation is given.

1. How accessible is the material? - The average response is 6.3 out of 10, indicating that the participants found the material to be barely accessible.
2. How difficult was it for you to use it? - The average response is 5.3 out of 10, indicating that the participants found the material somewhat difficult to use.
3. To what extent is training required to be able to use it? - The average response is 5.0 out of 10, indicating that the participants believed that some training is required to use the material effectively.
4. Would you use it if it was available to you? - The average response is 6.3 out of 10, indicating that the participants were ambivalent about using the material if it was available to them.
5. Would you recommend others to use it? - The average response is 7.3 out of 10, indicating that the participants may recommend others to use the material.
6. To what extent do you believe it will fill gaps of your existent knowledge? - The average response is 9 out of 10, indicating that the participants believe the material can effectively fill gaps in their knowledge.
7. Could you obtain the information/knowledge provided by this material in another way? - The average response is 6.3 out of 10, indicating that the participants were leaning towards obtaining the same information through other means.

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8. Do you think that the material successfully meets the purpose for which it was built? - The average response is 6 out of 10, indicating that the participants believe the material barely meets its intended purpose.
9. How useful would this material be for your university studies? - The average response is 7.6 out of 10, indicating that the participants think the material could be useful for their university studies.
10. How tedious is the material? - The average response is 6.6 out of 10, indicating that the participants found the material quite tedious.
11. How complex and complicated is the material? - The average response is 5.3 out of 10, indicating that the participants found the material a little complex.
12. How much load (memory and attention) does the material's use require? - The average response is 7.0 out of 10, indicating that the participants believe the material requires a considerable level of memory and attention.
13. How satisfied are you with the use of this material? - The average response is 6.0 out of 10, indicating that the participants were barely satisfied with the use of the material.

ePub – Textbook

Scenarios

The results of an evaluation of participants' performance on tasks involving an ePub textbook are presented in Tables 117-118.

Table 117 shows that five out of 6 participants were successful in completing the task " Find chapter 4 ‘Responsibility and Choice '". The average completion time was 45 seconds.

Participants	Success/Unsuccess	With/Without help	Time (sec)	Interruption for solution by himself, by help	Times of interruption
P1	S	without	12		0
P2	U				
P3	S	with	52	help	1
P4	S	without	140	help	2
P5	S	without	6	himself	0
P6	S	without	15	himself	0

Table 117. First task from ePub - Textbook

Table 118 displays that half of the participants (3 out of 6) were successful in completing the task “Go to page 16”.

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Participants	Success/Unsuccess	With/Without help	Time (sec)	Interruption for solution by himself, by help	Times of interruption
P1	S	without	79		0
P2	U				
P3	S	without	29		0
P4	S	without	110	help	1
P5	U	without	-	help	1
P6	U	with	-	help	1

Table 118: Second task from ePub Textbook

Independent exploration

One participant commented that the material was not tedious but learning how to explore it with the chosen software was. P2 got frustrated with Camera Mouse and opted out of the ePUB tasks after giving it a try.

Semi-structured interview

The semi-structured interview consisted of 6 questions, which are listed below along with the participants' answers.

1. We would like you to make a general comment on the material. How do you evaluate it (positive / negative)?

- Four participants gave a positive evaluation of the material, while one gave a negative one.

2. What would you keep and what would you change about it? How (in which way) would you change each item you suggest for a change? Can you suggest some changes and improvements?

Most participants would make changes:

- **Material:** Have visible page numbers for easy location.
- **Software:** the speed of Camera Mouse, stability, double clicking with blinking eye movements, add voice options

3. Could you obtain the information/ knowledge provided by this material in another way? e.g., using some or a combination of some other alternative forms of educational material? What are they? (Should be listed individually or in combination).

- **Alternative forms:** PDF, MS Word, PowerPoint, video, podcast, audio.

4. Where do you think this material would be helpful for you during your university studies (in which tasks / activities)?

- Academic tasks
- Studying
- Exams

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Despite finding the areas it would be useful in theory, three participants noted they would not use it in practice.

5. What are the advantages and disadvantages of this form of material?

Based on the responses of the participants, the advantages and disadvantages of the form of material are as follows:

Advantages:

- Chapter and page bar are useful.
- Integrated screen reader.
- Portable across more devices.
- Progress bar indicating the percentage of the book read.

Disadvantages:

- The content is not editable (not able to make notes, highlight, make bold).
- The button for changing pages is difficult to use.
- Absence of pane numbering within the document.

Usability Questionnaire

The questionnaire contained the following questions, for which the participants' answers are reported, and their interpretation is given.

1. How accessible is the material? - The average response is 6.6 out of 10, indicating that the participants found the material to be moderately accessible.
2. How difficult was it for you to use it? - The average response is 4 out of 10, suggesting that the participants found the material to have a moderate level of difficulty in terms of usability.
3. To what extent is training required to be able to use it? - The average response is 4 out of 10, indicating that the participants believed that some training may be necessary to use the material effectively.
4. Would you use it if it was available to you? - The average response is 7.4 out of 10, indicating a moderate level of willingness to use the material if it were available.
5. Would you recommend others to use it? - The average response is 8.6 out of 10, suggesting a participants would recommend the material to others.
6. To what extent do you believe it will fill gaps of your existent knowledge? - The average response is 5.8 out of 10, indicating a moderate belief that the material will help address existing knowledge gaps.
7. Could you obtain the information/knowledge provided by this material in another way? - The average response is 8 out of 10, suggesting that the participants perceived it was likely to obtain the same information or knowledge through alternative means.
8. Do you think that the material successfully meets the purpose for which it was built? - The average response is 5.6 out of 10, indicating the participants were ambivalent about the material meeting its intended purpose.
9. How useful would this material be for your university studies? - The average response is 8.2 out of 10, suggesting participants found the material useful for university studies.
10. How tedious is the material? - The average response is 5.8 out of 10, indicating a moderate level of tedium associated with the material.
11. How complex and complicated is the material? - The average response is 4.4 out of 10, suggesting a moderate perception of the material's complexity and level of complication.

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12. How much load (memory and attention) does the material's use require? - The average response is 5.0 out of 10, indicating a moderate level of load in terms of memory and attention required to use the material.
13. How satisfied are you with the use of this material? - The average response is 5.2 out of 10, suggesting a moderate level of satisfaction with the use of the material.

1.3. Study of Individuals with Hearing Impairments

1.3.1. Participants

There were 2 participants in the study [Participant 1 (P1) - Participant 2 (P2)]. One man (25 years old) (and one woman (24 years old). Both were from Spain and undergraduate students at the University of Alicante. One was studying Economics and Business and the other Engineering.

Both had bilateral hearing loss onset at 2 years of age, for one the cause was congenital and for the other otitis. One had severe hearing loss (71-90 dB) in both ears and oene had profound hearing loss (91+ dB) in both ears. Both were lip readers and understood the written language. They did not knw sign language and used assistive hearing devices, one had cochlear implants and the other used earphones.

1.3.2. Instruments

The tools used for the present study are as follows: a) questionnaire for collecting demographic information of the participants, b) scenarios with comprehension questions for navigating accessible educational material, c) semi-structured interviews for evaluating the accessible educational material, and d) questionnaire on the usability of the accessible educational material.

1.3.3. Procedure

The process of the experiment consists of a set of structured steps for collecting data and evaluating accessible educational material. The steps were as follows:

- Step 1. Participants answered the demographic questionnaire.
- Step 2. The scenario was implemented for each accessible educational material and comprehension questions were answered.
- Step 3. Participants independently explored the accessible educational material and commenting on its accessibility.
- Step 4. The semi-structured interview was conducted.
- Step 5. The usability questionnaire was completed.

1.3.4. Analysis

During the assessment, two of the three accessible educational materials were evaluated by the number of correct answers given by the participants in 3 comprehension questions: 1. How many

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people lost their lives? , 2. What is the problem with the road network? , 3. Why is the cyclist riding a bike in the snow?

The success rate of the materials along with the results from the semi-structured interviews and the questionnaire, will provide further information on how users interact with the material and how useful they consider it to be.

1.3.5. Results

The accessible education materials made for this part of the study was one video presented in multiple ways: a) with open captions, b) with closed captions and c) with sign language. However, since the participants did not know sign language, the tasks for the video with sign language were not completed.

Comprehension questions

The summarized results are presented in Table 119.

	Open Captions				Closed captions				Sign Language		
Participant	Q1*	Q2	Q3		Q1	Q2	Q3		Q1	Q2	Q3
P1	C	C	C		-	-	-		-	-	-
P2	U	C	C		-	-	-		-	-	-
The "C" indicates a correct answer and the "W" an incorrect / wrong answer.											
Q1 to Q3: Comprehension Questions 1 to 3											

Table 119: Summarized results in comprehension questions

Semi-structured interview

The semi-structured interview consisted of 5 questions, which are listed below along with the participants' answers.

1. We would like you to make a general comment on the material. How do you evaluate it (positive / negative)?

- Both participants evaluated the material positively.

2. What would you keep and what would you change about it? How (in which way) would you change each item you suggest for a change? Can you suggest some changes and improvements?

- Both participants would keep the subtitles. One of them also liked the simultaneous provision of subtitles and sign language because they are not usually provided both at once, but would improve the synchronization of the subtitles.

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3. Could you obtain the information/ knowledge provided by this material in another way? e.g., using some or a combination of some other alternative forms of educational material? What are they? (Should be listed individually or in combination).

Alternative means: written document (i.e., Word, PDF, PowerPoint), FM transmitters, transcription of the information

4. Where do you think this material would be helpful for you during your university studies (in which tasks / activities)?

- Both participants found the material helpful in all classes. One participant thought that all professors could use subtitles in their classes. The other thought subtitles would be especially helpful in all subjects that involve audiovisual components, such as Business Administration.

5. What are the advantages and disadvantages of this form of material?

Based on the participants' responses, we can group the advantages and disadvantages of the material into the following themes:

Advantages:

- Provides access to information as it compensates for background noise in classroom.
- Enabling someone to follow the speech when impossible with auditory channel.
- Facilitate access to video.

Both participants did not mention disadvantages with one of them noting they could not find any.

Questionnaire

The questionnaire contained the following questions, for which the participants' answers are reported and their interpretation is given.

1. How accessible is the material? - The respondents rated the accessibility of the material with an average score of 9.5. This suggests that the material is easy to access.
2. How difficult was it for you to use it? The respondents rated the accessibility of the material with an average score of 2. This indicates that the material is easy to use.
3. To what extent is training required to be able to use it? - The scores have an average of 1, indicating no training is required for this type of material.
4. Would you use it if it was available to you? The respondents indicated that they would certainly use the material if it was available to them with an average score of 10.
5. Would you recommend others to use it? - The respondents indicated that they would certainly recommend others to use the material with an average score of 10.
6. To what extent do you believe it will fill gaps of your existent knowledge? - The respondents indicated that the material would fill some gaps in knowledge with an average score of 7.5.
7. Could you obtain the information/ knowledge provided by this material in another way? - The respondents indicated that they could obtain the information through other means with an average score of 7.5.

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8. Do you think that the material successfully meets the purpose for which it was built? - Respondents believed that the material successfully meets its purpose with an average score of 9.5.
9. How useful would this material be for your university studies? - The respondents rated the usefulness of the material for their university studies between with an average score of 9.5. This suggests that the material would be very useful for their studies.
10. How tedious is the material? The respondents rated the material as not very tedious, with an average score of 1.5.
11. How complex and complicated is the material? - The respondents rated the complexity and complication of the material between 1. This suggests that the material is not complex or complicated.
12. How much load (memory and attention) does the material's use require? - The scores for the amount of memory and attention required to use the material had an average of 1 suggesting the material does not particularly require memory or attention.
13. How satisfied are you with the use of this material? - The respondents were clearly satisfied with an average score of 10.

1.4. Study of Individuals with Specific Learning Disabilities

1.4.1. Participants

There were 5 participants with specific learning disabilities in the study. Three were women and two were men. Their mean age was 24.4 years old. Three were from Italy and two from Spain. All were undergraduate students, three at the University of Genoa, one at the University of Alicante and one at the Technological University of Panama. Two were studying at the Department of Education Sciences, one at the Department of Economics, one at the Department of Advertising and Public Relations and one at the Department of Industrial Engineering.

One participant reported having dysorthography and dyslexia, one dysorthography, dysgraphia and dyslexia, one dyslexia and dyscalculia, one dyslexia and one general learning disabilities without specifying. Their learning disabilities were diagnosed between the ages of 6 and 17. Regarding oral language, four found it very easy or easy to understand and one found it neutral. Regarding the written language, three found it easy and two neautral to understand.

1.4.2. Instruments

The tools used for the present study are as follows: a) questionnaire for collecting demographic information of the participants, b) scenarios of activities for navigating accessible educational material with comprehension questions on specific material, c) semi-structured interviews for evaluating the accessible educational material, and d) questionnaire on the usability of the accessible educational material.

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1.4.3. Procedure

The process of the experiment consists of a set of structured steps for collecting data and evaluating the accessible educational material. The use of multiple tools such as the semi-structured interview and the usability questionnaire can provide further information on how users interact with the accessible educational material and how useful they consider it to be. The steps were as follows:

- Step 1. Participants answered the demographic questionnaire.
- Step 2. The scenario was implemented for each accessible educational material with comprehension questions where needed.
- Step 3. Participants independently explored the accessible educational material following a think aloud protocol.
- Step 4. The semi-structured interview was conducted.
- Step 5. The usability questionnaire was completed.

1.4.4. Analysis

During the assessment of accessible educational material, the following variables were used to measure the effectiveness of the educational material in achieving the desired learning outcomes.

- Success/Unsuccess: This variable indicates whether the participant was successful or unsuccessful in completing the scenario.
- With/without help: This variable indicates whether the participant completed the scenario with or without assistance.
- Time: This variable measures the time taken by the participant to complete the scenario.
- Interruption for solution by himself, by help: This variable measures the number of times the participant was interrupted and needed help to find a solution to complete the scenario.
- Times of interruption: This variable measures the total number of interruptions experienced by the participant during the completion of the scenario.

By collecting and analyzing these variables, researchers and educators can identify areas where participants may be struggling or where the educational material needs improvement to better support learning outcomes.

1.4.5. Results

The results for each accessible educational material are presented. The accessible educational material included the MS Word textbook, which was a book without (complex) images and tables. The same book was also examined in three other formats (PDF-textbook and Epub-Textbook). In order to compare the formats, participants performed the same tasks in each format (Word, PDF, ePub). Other accessible educational materials were a ppt presentation, , mathematical and chemical equations with verbal descriptions and / or produced with MathType.

MS Word – Textbook

Scenarios

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Tables 120-121 present the results of an assessment of five participants' completion tasks involving a Word textbook.

Table 120 shows that all participants were successful in completing the task "Go to sub-chapter 'CHOICE' in chapter 4 'Responsibility and Choice '", listen to the third paragraph and then repeat the types of motivation mentioned.". Most participants received help to complete the task. The average completion time was 131 seconds.

Participants	Success/Unsuccess	With/Without help	Time (sec)	Interruption for solution by himself, by help	Times of interruption
P1	S	without	60	himself	0
P2	S	with	150	himself	0
P3	S	with	180	help	0
P4	S	with	105	help	1
P5	S	with	160	help	1

Table 120. First task from MS Word – Textbook

Table 121 displays that four out of 5 participants were successful in completing the task "Go to chapter 7 'Strength and Weakness of Will' listen to the first paragraph and then tell us which are the other possibilities besides having a good or bad character". The average completion time was 125 seconds.

Participants	Success/Unsuccess	With/Without help	Time (sec)	Interruption for solution by himself, by help	Times of interruption
P1	S	without	60	himself	0
P2	S	with	150	himself	0
P3	S	with	180	help	0
P4	S	without	75	himself	0
P5	U	with	158	help	1

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Table 121. Second task from MS Word Textbook

Semi-structured interview

The semi-structured interview consisted of 5 questions, which are listed below along with the participants' answers.

1. We would like you to make a general comment on the material. How do you evaluate it (positive / negative)?

- Three participants had positive evaluations of the material when asked to provide a general comment, while two had neautral.

2. What would you keep and what would you change about it? How (in which way) would you change each item you suggest for a change? Can you suggest some changes and improvements

One participant reported that they would not change a thing in the book presented during the task. Other participants suggested keeping or changing the following:

- Keep: the index
- Improve / Change: audio quality, the speed and punctuation of the synthetic voice

3. Could you obtain the information/ knowledge provided by this material in another way? e.g., using some or a combination of some other alternative forms of educational material? What are they? (Should be listed individually or in combination).

- **Alternative formats**: diagrams, mental and conceptual maps, multimedia (animations and videos).

4. Where do you think this material would be helpful for you during your university studies (in which tasks / activities)?

- Academic tasks, mainly projects and essays
- Exams
- Lecture notes
- Studying (to speed up reading times)
- Personal reading

Based on the answers given by the participants, it seems that the material provided would be useful for various tasks and activities during their university studies.

5. What are the advantages and disadvantages of this form of material?

Advantages

- Give more freedom
- Adaptable
- Customizable
- Editable (access to text-based information to which you can contribute directly)
- Flexible

Disadvantages

- Not suitable for scientific disciplines.

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ΙΔΡΥΜΑ ΚΡΑΤΙΚΩΝ ΥΠΟΤΡΟΦΙΩΝ ΙΚΥ

- NVDA is superfluous for dyslexics
- Typing on a computer makes it harder to understand and retain information
- It has few references to follow an order.

Overall, it seems it is important to consider individual preferences and needs when selecting a format for reading and accessing information.

Usability Questionnaire

A usability questionnaire used to gather feedback from users regarding the accessibility, usability, and effectiveness of the material. The questionnaire aims to identify any potential issues or barriers that users may encounter when accessing or using the material. The feedback collected can then be used to improve the design and accessibility of the educational material, making it more effective and user-friendly for individuals with visual impairments. Additionally, the questionnaire can help ensure that the educational material meets accessibility standards and guidelines.

The questionnaire contained the following questions, for which the participants' answers are reported, and their interpretation is given.

1. How accessible is the material? - The respondents rated the accessibility of the material with an average score of 9.8 as the majority rated the material with 10. This suggests that the material is easy to access.
2. How difficult was it for you to use it? The average score was 1 indicating that the material is very easy to use.
3. To what extent is training required to be able to use it? - The scores for the amount of training required to use the material varied had an average of 1.
4. Would you use it if it was available to you? The average score was 5.6, showing the participants were ambivalent about using it if it were available.
5. Would you recommend others to use it? - The respondents were ambivalent but leaning towards recommending the material with an average score of 6.
6. To what extent do you believe it will fill gaps of your existent knowledge? – The average score was 5.8 showing participants were ambivalent about knowledge gaps being filled by this material.
7. Could you obtain the information/ knowledge provided by this material in another way? - The average score was 8.4 showing that participants believe other means are available for obtaining the same information / knowledge.
8. Do you think that the material successfully meets the purpose for which it was built? - Respondents generally believed that the material successfully meets the purpose for which it was built with an average score of 8.
9. How useful would this material be for your university studies? - The respondents rated the usefulness of the material for their university studies with an average score of 7.8. This suggests that the material could be very useful for their studies.
10. How tedious is the material? The respondents rated the material as not very tedious, with an average score of 2.6.
11. How complex and complicated is the material? - The respondents rated the complexity and complication of the material, with an average score of 1.8. This suggests that the material is not complex or complicated.

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12. How much load (memory and attention) does the material's use require? - The scores for the amount of memory and attention required to use the material varied, with an average score of 2.
13. How satisfied are you with the use of this material? - The respondents rated their satisfaction with the use of the material with an average score of 6.8.

PDF – Textbook

Scenarios

Tables 122-123 present the results of an assessment of participants' completion tasks involving a PDF textbook.

Table 122 shows that all participants were successful in completing the task " Go to sub-chapter 'CHOICE' in chapter 4 'Responsibility and Choice '", listen to the third paragraph and then repeat the types of motivation mentioned". The average completion time was 70 seconds.

Participants	Success/Unsuccess	With/Without help	Time (sec)	Interruption for solution by himself, by help	Times of interruption
P1	S	with	90	himself	0
P2	S	-	-		-
P3	S	-	-		-
P4	S	without	74	himself	0
P5	S	without	46	himself	0

Table 122. First task from the PDF - Textbook

Table 123 displays that four out of 5 participants were successful in completing the task "Go to chapter 7 'Strength and Weakness of Will' listen to the first paragraph and then tell us which are the other possibilities besides having a good or bad character". The average completion time was 56.6 seconds.

Participants	Success/Unsuccess	With/Without	Time	Interruption for solution	Times of

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ΙΔΡΥΜΑ ΚΡΑΤΙΚΩΝ ΥΠΟΤΡΟΦΙΩΝ IKY

		help	(sec)	by himself, by help	interruption
P1	S	with	90		0
P2	S	-	-	-	-
P3	S	-	-	-	-
P4	S	without	45	himself	0
P5	U	without	35	himself	0

Table 123. Second task for the PDF Textbook

Independent exploration

Participants commented on liking the punctuation and speed of the synthetic voice reading the text better on the PDF textbook than on MS Word.

Semi-structured interview

The semi-structured interview consisted of 5 questions, which are listed below along with the participants' answers.

1. We would like you to make a general comment on the material. How do you evaluate it (positive / negative)?

- Three participants had positive evaluations of the material when asked to provide a general comment, while two had neautral.

2. What would you keep and what would you change about it? How (in which way) would you change each item you suggest for a change? Can you suggest some changes and improvements

One participant reported that they would not change a thing in the book presented during the task. Other participants suggested keeping or changing the following:

- Keep: comfort it provides for reading
- Improve / Change: audio quality, the speed and punctuation of the synthetic voice

3. Could you obtain the information/ knowledge provided by this material in another way? e.g., using some or a combination of some other alternative forms of educational material? What are they? (Should be listed individually or in combination).

- **Alternative formats**: diagrams, mental and conceptual maps, multimedia (animations and videos).

4. Where do you think this material would be helpful for you during your university studies (in which tasks / activities)?

- Academic tasks, mainly projects and essays
- Exams
- Lecture notes

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- Studying (to speed up reading times)
- Personal reading

Based on the answers given by the participants, it seems that the material provided would be useful for various tasks and activities during their university studies similarly to MS Word.

5. What are the advantages and disadvantages of this form of material?

Advantages

- Give more freedom
- Adaptable
- Customizable
- You can write by hand directly on top of the fixed text
- Easier to download
- More convenient to print

Disadvantages

- Not suitable for scientific disciplines.
- NVDA is superfluous for dyslexics
- Need for specific software
- Closed format / not editable.

Overall, it seems it is important to consider individual preferences and needs when selecting a format for reading and accessing information.

Usability Questionnaire

The questionnaire contained the following questions, for which the participants' answers are reported, and their interpretation is given.

1. How accessible is the material? - The respondents rated the accessibility of the material with an average score of 9.8 as the majority rated the material with 10. This suggests that the material is easy to access.
2. How difficult was it for you to use it? The average score was 1 indicating that the material is very easy to use.
3. To what extent is training required to be able to use it? - The scores for the amount of training required to use the material varied had an average of 1.
4. Would you use it if it was available to you? The average score was 5.6, showing the participants were ambivalent about using it if it were available.
5. Would you recommend others to use it? - The respondents were ambivalent but leaning towards recommending the material with an average score of 6.
6. To what extent do you believe it will fill gaps of your existent knowledge? – The average score was 5.8 showing participants were ambivalent about knowledge gaps being filled by this material.
7. Could you obtain the information/ knowledge provided by this material in another way? - The average score was 8.4 showing that participants believe other means are available for obtaining the same information / knowledge.
8. Do you think that the material successfully meets the purpose for which it was built? - Respondents generally believed that the material successfully meets the purpose for which it was built with an average score of 8.2.

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9. How useful would this material be for your university studies? - The respondents rated the usefulness of the material for their university studies with an average score of 7.8. This suggests that the material could be very useful for their studies.
10. How tedious is the material? The respondents rated the material as not very tedious, with an average score of 2.2.
11. How complex and complicated is the material? - The respondents rated the complexity and complication of the material, with an average score of 1.2. This suggests that the material is not complex or complicated.
12. How much load (memory and attention) does the material's use require? - The scores for the amount of memory and attention required to use the material varied, with an average score of 2.
13. How satisfied are you with the use of this material? - The respondents rated their satisfaction with the use of the material with an average score of 7.

ePub – Textbook

Scenarios

The results of an evaluation of participants' performance tasks involving an ePub textbook are presented in Tables 124-125.

Table 124 shows that all participants were successful in completing the task "Go to sub-chapter 'CHOICE' in chapter 4 'Responsibility and Choice '", listen to the third paragraph and then repeat the types of motivation mentioned", most of them without help. The average completion time was 125 seconds.

Participants	Success/Unsuccess	With/Without help	Time (sec)	Interruption for solution by himself, by help	Times of interruption
P1	S	without	120	himself	0
P2	S	without	300	help	0
P3	S	with	60	help	0
P4	S	without	65	himself	0
P5	S	without	80	himself	0

Table 124. First task from ePub-Textbook

Table 125 displays that all participants were successful in completing the task "Go to chapter 7 'Strength and Weakness of Will' listen to the first paragraph and then tell us which are the other

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possibilities besides having a good or bad character". The average completion time was 120.8 seconds.

Participants	Success/Unsuccess	With/Without help	Time (sec)	Interruption for solution by himself, by help	Times of interruption
P1	S	without	120	himself	0
P2	S	without	300	help	0
P3	S	with	60	help	0
P4	S	without	74	himself	0
P5	S	without	50	himself	0

Table 125. Second task from ePub-Textbook

Independent exploration

Similarly to the PDF textbook, participants commented on liking the punctuation and speed of the synthetic voice reading the text better on the ePub textbook than on MS Word.

Semi-structured interview

The semi-structured interview consisted of 6 questions, which are listed below along with the participants' answers.

1. We would like you to make a general comment on the material. How do you evaluate it (positive / negative)?

- Three participants gave a positive evaluation, one gave a neautral evaluation and one participant a negative evaluation.Participants also noted that they prefer the synthetic voice of Thorium Reader as it is slower and more suitable to their needs.

2. What would you keep and what would you change about it? How (in which way) would you change each item you suggest for a change? Can you suggest some changes and improvements?

One participant reported that they would not change a thing in the book presented during the task. Other participants suggested keeping or changing the following:

- Keep: Reading voice which is slower and has better punctuation (would not use NVDA)
- Improve / Change: audio quality, search index

3. Could you obtain the information/ knowledge provided by this material in another way? e.g., using some or a combination of some other alternative forms of educational material? What are they? (Should be listed individually or in combination).

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All five participants reported they could obtain the same information / knowledge by other means. However, only one of them specified by providing alternative formats. Another participant mentioned that the formats chosen depended on the depth of knowledge you want.

- **Alternative formats**: diagrams, mental and conceptual maps, multimedia (animations and videos).

4. Where do you think this material would be helpful for you during your university studies (in which tasks / activities)?

- Academic tasks, mainly projects and essays
- Exams
- Lecture notes
- Studying (to speed up reading times)
- Personal reading

Based on the answers given by the participants, it seems that the material provided would be useful for various tasks and activities during their university studies similarly to MS Word.

5. What are the advantages and disadvantages of this form of material?

Based on the responses of the participants, the advantages and disadvantages of the form of material are as follows:

Advantages

- Give more freedom
- Adaptable
- Customizable
- Promotes format changes.

Disadvantages

- Not suitable for scientific disciplines.
- Non-editable (You cannot take handwritten notes on top of the text)

Overall, it seems it is important to consider individual preferences and needs when selecting a format for reading and accessing information.

Usability Questionnaire

1. How accessible is the material? - The average score of 8 out of 10 suggests that the material is accessible.
2. How difficult was it for you to use it? - The average score of 3.4 suggests that the material is somewhat difficult to use and should be made to be more user-friendly.
3. To what extent is training required to be able to use it? - The average score of 3.2 suggests that some training is required to use the material effectively.
4. Would you use it if it was available to you? - The average score of 5.2 out of 10 suggests that participants were ambivalent about using the material again.
5. Would you recommend others to use it? The average score of 5.2 out of 10 suggests that participants were ambivalent about recommending the material to others.
6. To what extent do you believe it will fill gaps of your existent knowledge? - The average score of 4.2 out of 10 suggests that the material is not sufficiently effective in filling gaps in knowledge.

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7. Could you obtain the information/ knowledge provided by this material in another way? - The average score of 8.4 out of 10 suggests that the information/knowledge provided by the material could be obtained through other sources.
8. Do you think that the material successfully meets the purpose for which it was built? - The average score of 7 out of 10 suggests that the material meets the purpose for which it was built but could be improved.
9. How useful would this material be for your university studies? - The average score of 6 out of 10 suggests that the material may not be very useful for university studies.
10. How tedious is the material? - The average score of 3.4 out of 10 suggests that the material is a little tedious.
11. How complex and complicated is the material? - The average score of 2.2 out of 10 suggests that the material is not very complex and complicated.
12. How much load (memory and attention) does the material's use require? - The average score of 2 out of 10 suggests that the material does not require a sifnificant amount of memory and attention.
13. How satisfied are you with the use of this material? - The average score of 6.4 out of 10 suggests that the respondents are slightly satisfied with the use of the material, but there is room for improvement.

Power Point presentation

Scenarios

Table 126 provides information on the results of an assessment of participants' completion of tasks involving a Power Point presentation. Each task was comprised of one comprehension question.

All five participants answered both questions correctly. The questions were:

Q1: What are the types of human rights??

Q2: What is at the center of our political rights?

Participants	Question 1	Question 2
P1	Correct	Correct
P2	Correct	Correct
P3	Correct	Correct
P4	Correct	Correct
P5	Correct	Correct

Table 126. Comprehension questions for PowerPoint presentation

Independent exploration

Participants commented that material in digital format is generally positive and that the presentation used in the study allowed fast exploration.

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Semi-structured interview

The semi-structured interview consisted of 5 questions, which are listed below along with the participants' answers.

1. We would like you to make a general comment on the material. How do you evaluate it (positive / negative)?

- Four participants evaluated the material positively and one was neutral.

2. What would you keep and what would you change about it? How (in which way) would you change each item you suggest for a change? Can you suggest some changes and improvements?

- Four participants had no suggestions for improvements. One participant suggested improvements for the reader; slower reading and better punctuation.

3. Could you obtain the information/ knowledge provided by this material in another way? e.g., using some or a combination of some other alternative forms of educational material? What are they? (Should be listed individually or in combination).

- **Alternative formats**: audiovideo, powerpoint with integrated reading, video, diagrams, mental and conceptual maps, multimedia (animations), oral explanations in class with a written guide where you can add handwritten notes.

4. Where do you think this material would be helpful for you during your university studies (in which tasks / activities)?

- Taking notes
- Studying (speed up reading times, revision)
- Exams
- Academic tasks
- Personal reading

One participant noted “In general, when gathering and managing theoretical information or explanations: the more variety of formats, the better for me”. This again highlighted the importantance of following the Universal Design for Learning principles and considering individual preferences and needs.

5. What are the advantages and disadvantages of this form of material?

Based on the responses of the participants, the advantages and disadvantages of the form of material are as follows:

Advantages

- Ease of handling: little text and few distracting elements
- Give more freedom
- Adaptable
- Customizable
- Very visual so you find the information quickly
- More comfortable and intuitive than Word.

Disadvantages

- Not suitable for scientific disciplines

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- Depends on the format and quantity of slides.

Overall, the participants found more advantages than disadvantages of this form of material.

Usability Questionnaire

1. How accessible is the material? - The average response is 9.8 out of 10, indicating that the participants found the material to be highly accessible.
2. How difficult was it for you to use it? - The average response is 1 out of 10 indicating that the participants found the material easy to use.
3. To what extent is training required to be able to use it? - The average response is 1 out of 10, indicating that no training is required to use the material effectively.
4. Would you use it if it was available to you? - The average response is 9 out of 10, indicating that the participants would be likely to use the material if it was available to them.
5. Would you recommend others to use it? - The average response is 8.8 out of 10, indicating that the participants would be likely to recommend the material to others.
6. To what extent do you believe it will fill gaps of your existent knowledge? - The average response is 6.2 out of 10, indicating that the participants were not very positive on the potential of the material to fill gaps in knowledge.
7. Could you obtain the information/ knowledge provided by this material in another way? - The average response is 7 out of 10, indicating that participants believe the information could possibly be obtained through other means.
8. Do you think that the material successfully meets the purpose for which it was built? - The average response is 7.6 out of 10, indicating that the participants believe the material is quite successful in meeting its purpose, but does not entirely fulfill it.
9. How useful would this material be for your university studies? - The average response is 7.8 out of 10, indicating that the participants believe the material has the potential to be useful for their university studies.
10. How tedious is the material? - The average response is 1.6 out of 10, indicating that the participants did not find the material tedious.
11. How complex and complicated is the material? - The average response is 1 out of 10, indicating that the participants did not find the material complex or complicated at all.
12. How much load (memory and attention) does the material's use require? - The average response is 1.6 out of 10, indicating that the participants found the material to require an insignificant level of memory and attention.
13. How satisfied are you with the use of this material? - The average response is 7.8 out of 10, indicating that the participants were satisfied but there is room for improvement.

Chem

Chem with MathML

Scenarios

In the first task (Listen to chemical equation 1 and repeat what you heard) all participants were successful. The average completion time was 41.8 seconds.

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ΙΔΡΥΜΑ ΚΡΑΤΙΚΩΝ ΥΠΟΤΡΟΦΙΩΝ IKY

Participants	Success/Unsuccess	With/Without help	Time (sec)	Interruption for solution by himself, by help	Times of interruption
P1	S	With	60	help	0
P2	S	With	58	help	0
P3	S	With	59	help	0
P4	S	Without	20	himself	0
P5	S	Without	12	himself	1

Table 127. First task from CHEM with MathML

In the second task (Listen to chemical equation 2 and repeat what you heard), all participants were successful. The average completion time was 39.2 seconds.

Participants	Success/Unsuccess	With/Without help	Time (sec)	Interruption for solution by himself, by help	Times of interruption
P1	S	With	50	help	0
P2	S	Without	55	himself	0
P3	S	With	54	himself	0
P4	S	Without	19	himself	0
P5	S	Without	18	himself	0

Table 128. Second task from CHEM with MathML

In the third task (Listen to chemical equation 3 and repeat what you heard), all participants were successful without help. The average completion time was 36.6 seconds.

Participants	Success/Unsuccess	With/Without help	Time (sec)	Interruption for solution by himself,	Times of interruption

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ΙΔΡΥΜΑ ΚΡΑΤΙΚΩΝ ΥΠΟΤΡΟΦΙΩΝ IKY

				by help	
P1	S	Without	42	himself	0
P2	S	Without	47	himself	0
P3	S	Without	48	himself	0
P4	S	Without	27	himself	1
P5	S	Without	19	himself	0

Table 129. Third task from CHEM with MathML

In the fourth task (Listen to chemical equation 4 and repeat what you heard), all participants were successful without help. The average completion time was 28.4 seconds.

Participants	Success/Unsuccess	With/Without help	Time (sec)	Interruption for solution by himself, by help	Times of interruption
P1	S	Without	40	himself	0
P2	S	Without	39	himself	0
P3	S	Without	43	himself	0
P4	S	Without	9	himself	0
P5	S	Without	11	himself	0

Table 130. Fourth task from CHEM with MathML

In the fifth task (Listen to chemical equation 5 and repeat what you heard), all participants were successful without help. The average completion time was 24.8 seconds.

Participants	Success/Unsuccess	With/Without help	Time (sec)	Interruption for solution by himself, by help	Times of interruption
P1	S	Without	38	himself	0

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P2	S	Without	28	himself	0
P3	S	Without	37	himself	0
P4	S	Without	9	himself	0
P5	S	Without	12	himself	0

Table 131. Fifth task from CHEM with MathML

Semi-structured interview

The answers in the five questions are presented below.

1. We would like you to make a general comment on the material. How do you evaluate it (positive / negative)?

- All participants evaluated the material positively.

2. What would you keep and what would you change about it? How (in which way) would you change each item you suggest for a change? Can you suggest some changes and improvements?

- All participants reported they did not have any changes / improvements to suggest.

3. Could you obtain the information/ knowledge provided by this material in another way? e.g., using some or a combination of some other alternative forms of educational material? What are they? (Should be listed individually or in combination).

- All participants reported they could obtain the same information with other means but none specified.

4. Where do you think this material would be helpful for you during your university studies (in which tasks / activities)?

- All participants reported that the material would be useful for their studies in general with one participant specifying it would be useful for Chemistry classes.

5. What are the advantages and disadvantages of this form of material?

Based on the participants' responses, the main advantage of the material was the usefulness of the synthetic voice. One participant commented that the voice was great.

Usability Questionnaire

The questionnaire was completed by both participants.

1. How accessible is the material? – The average response was 7.6 out of 10 showing the material was accessible but could be improved.
2. How difficult was it for you to use it? - The average response was 2.2 out of 10.
3. To what extent is training required to be able to use it? - The average response was 1.8 out of 10.
4. Would you use it if it was available to you? - The average response was 7.2 out of 10.
5. Would you recommend others to use it? - The average response was 7.4 out of 10.

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6. To what extent do you believe it will fill gaps of your existent knowledge? - The average response was 5 out of 10.
7. Could you obtain the information/knowledge provided by this material in another way? – The average response was 7.6 out of 10 showing that participants believed they could somewhat obtain the same information in other ways.
8. Do you think that the material successfully meets the purpose for which it was built? - The average response was 7.2 out of 10.
9. How useful would this material be for your university studies? - The average response was 6.4 out of 10.
10. How tedious is the material? The average response was 1.4 out of 10.
11. How complex and complicated is the material? - The average response was 2.2 out of 10.
12. How much load (memory and attention) does the material's use require? - The average response was 1.4 out of 10.
13. How satisfied are you with the use of this material? - The average response was 6.8 out of 10.

Chem with Verbal Description

Scenarios

In the first task (Listen to chemical equation 1 and repeat what you heard) all participants were successful. The average completion time was 33.8 seconds.

Participants	Success/Unsuccess	With/Without help	Time (sec)	Interruption for solution by himself, by help	Times of interruption
P1	S	With	51	help	0
P2	S	With	48	help	0
P3	S	With	57	help	0
P4	S	Without	5	himself	0
P5	S	Without	8	himself	1

Table 132. First task from CHEM with VD

In the second task (Listen to chemical equation 2 and repeat what you heard), all participants were successful without help. The average completion time was 32 seconds.

Participants	Success/Unsuccess	With/Without	Time	Interruption for solution	Times of

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ΙΔΡΥΜΑ ΚΡΑΤΙΚΩΝ ΥΠΟΤΡΟΦΙΩΝ IKY

		help	(sec)	by himself, by help	interruption
P1	S	Without	49	help	0
P2	S	Without	45	himself	0
P3	S	Without	53	help	0
P4	S	Without	6	himself	0
P5	S	Without	7	himself	0

Table 133. Second task from CHEM with VD

In the third task (Listen to chemical equation 3 and repeat what you heard), all participants were successful without help. The average completion time was 30 seconds.

Participants	Success/Unsuccess	With/Without help	Time (sec)	Interruption for solution by himself, by help	Times of interruption
P1	S	Without	45	himself	0
P2	S	Without	43	himself	0
P3	S	Without	50	himself	0
P4	S	Without	6	himself	0
P5	S	Without	6	himself	0

Table 134. Third task from CHEM with VD

In the fourth task (Listen to chemical equation 4 and repeat what you heard), all participants were successful without help. The average completion time was 30 seconds.

Participants	Success/Unsuccess	With/Without help	Time (sec)	Interruption for solution by himself, by help	Times of interruption

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ΙΔΡΥΜΑ ΚΡΑΤΙΚΩΝ ΥΠΟΤΡΟΦΙΩΝ IKY

P1	S	without	38	himself	0
P2	S	without	41	himself	0
P3	S	without	47	himself	0
P4	S	without	11	himself	0
P5	S	without	13	himself	0

Table 135. Fourth task from CHEM with VD

In the fifth task (Listen to chemical equation 5 and repeat what you heard), four out of five participants were successful without help. The average completion time was 28.2 seconds.

Participants	Success/Unsuccess	**With/Without help**	**Time (sec)**	**Interruption for solution by himself, by help**	**Times of interruption**
P1	S	Without	35	himself	0
P2	S	Without	39	himself	0
P3	S	Without	36	himself	0
P4	U	With	16	help	1
P5	S	Without	15	himself	0

Table 136. Fifth task from CHEM with VD

Semi-structured interview

1. We would like you to make a general comment on the material. How do you evaluate it (positive / negative)?

- Two participants evaluated the material positively and three nagatively.

2. What would you keep and what would you change about it? How (in which way) would you change each item you suggest for a change? Can you suggest some changes and improvements?

- Three participants reported they did not have any changes / improvements to suggest. Two participants found the meaning of the elements hard and did not make specific suggestions.

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ΙΔΡΥΜΑ ΚΡΑΤΙΚΩΝ ΥΠΟΤΡΟΦΙΩΝ IKY

3. Could you obtain the information/ knowledge provided by this material in another way? e.g., using some or a combination of some other alternative forms of educational material? What are they? (Should be listed individually or in combination).

- All participants reported they could obtain the same information with other means but none specified.

4. Where do you think this material would be helpful for you during your university studies (in which tasks / activities)?

- All participants reported that the material would be useful for their studies in general with one participant specifying it would be useful for Chemistry classes.

5. What are the advantages and disadvantages of this form of material?

Based on the participants' responses, the main advantage of the material was the usefulness of the synthetic voice. A disadvantage pinpointed by two participants was the inability to add annotations.

Usability Questionnaire

The questionnaire was completed by both participants.

1. How accessible is the material? – The average response was 5.6 out of 10 showing the participants were ambivalent about the level of accessibility of the material. Consequently, the material could be significantly improved.
2. How difficult was it for you to use it? - The average response was 4.6 out of 10.
3. To what extent is training required to be able to use it? - The average response was 2.2 out of 10.
4. Would you use it if it was available to you? - The average response was 2.6 out of 10.
5. Would you recommend others to use it? - The average response was 2.6 out of 10.
6. To what extent do you believe it will fill gaps of your existent knowledge? - The average response was 3.4 out of 10.
7. Could you obtain the information/knowledge provided by this material in another way? – The average response was 7.6 out of 10 showing that participants believed they could somewhat obtain the same information in other ways.
8. Do you think that the material successfully meets the purpose for which it was built? - The average response was 3.8 out of 10.
9. How useful would this material be for your university studies? - The average response was 3.4 out of 10.
10. How tedious is the material? The average response was 2.8 out of 10.
11. How complex and complicated is the material? - The average response was 3.2 out of 10.
12. How much load (memory and attention) does the material's use require? - The average response was 2 out of 10.
13. How satisfied are you with the use of this material? - The average response was 5.2 out of 10.

Math

MathML

Scenarios

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In the first task (Listen to mathematical equation 1 and repeat what you heard), all participants were successful. The average completion time was 44.8 seconds.

Participants	Success/Unsuccess	With/Without help	Time (sec)	Interruption for solution by himself, by help	Times of interruption
P1	S	With	50	help	0
P2	S	With	60	help	0
P3	S	With	62	help	0
P4	S	Without	25	himself	0
P5	S	Without	27	himself	0

Table 137. First task from MathML

In the second task (Listen to mathematical equation 2 and repeat what you heard), all participants were successful. The average completion time was 39 seconds.

Participants	Success/Unsuccess	With/Without help	Time (sec)	Interruption for solution by himself, by help	Times of interruption
P1	S	Without	45	himself	0
P2	S	With	55	help	0
P3	S	Without	58	help	0
P4	S	Without	16	himself	0
P5	S	Without	21	himself	0

Table 138. Second task from MathML

In the third task (Listen to mathematical equation 3 and repeat what you heard), four out of 5 participants were successful without help. The average completion time was 35 seconds.

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Participants	Success/Unsuccess	With/Without help	Time (sec)	Interruption for solution by himself, by help	Times of interruption
P1	S	Without	40	himself	0
P2	S	Without	45	himself	0
P3	S	Without	50	himself	0
P4	U	Without	30	himself	1
P5	S	Without	10	himself	0

Table 139. Third task from MathML

In the fourth task (Listen to mathematical equation 4 and repeat what you heard), all participants were successful without help. The average completion time was 26.4 seconds.

Participants	Success/Unsuccess	With/Without help	Time (sec)	Interruption for solution by himself, by help	Times of interruption
P1	S	Without	30	himself	0
P2	S	Without	40	himself	0
P3	S	Without	45	himself	0
P4	S	Without	10	himself	0
P5	S	Without	7	himself	0

Table 140. Fourth task from MathML

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In the fifth task (Listen to mathematical equation 5 and repeat what you heard), all participants were successful without help. The average completion time was 21 seconds.

Participants	Success/Unsuccess	With/Without help	Time (sec)	Interruption for solution by himself, by help	Times of interruption
P1	S	Without	25	himself	0
P2	S	Without	30	himself	0
P3	S	Without	40	himself	0
P4	S	Without	7	himself	0
P5	S	Without	3	himself	0

Table 141. Fifth task from MathML

Semi-structured interview

The answers in the five questions are presented below.

1. We would like you to make a general comment on the material. How do you evaluate it (positive / negative)?

- All participants evaluated the material positively.

2. What would you keep and what would you change about it? How (in which way) would you change each item you suggest for a change? Can you suggest some changes and improvements?

- All participants reported they did not have any changes to suggest.

3. Could you obtain the information/ knowledge provided by this material in another way? e.g., using some or a combination of some other alternative forms of educational material? What are they? (Should be listed individually or in combination).

- All participants reported they could obtain the same information with other means but none specified.

4. Where do you think this material would be helpful for you during your university studies (in which tasks / activities)?

- All participants reported that the material would be useful for their classes and studies in general.

5. What are the advantages and disadvantages of this form of material?

Based on the participants' responses, the main advantage of the material was the usefulness of the synthetic voice. Two participants commented that the reading voice was great.

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Usability Questionnaire

The questionnaire was completed by both participants.

1. How accessible is the material? – The average response was 7.6 out of 10 showing the material was accessible but could be improved.
2. How difficult was it for you to use it? - The average response was 1.8 out of 10.
3. To what extent is training required to be able to use it? - The average response was 1.2 out of 10.
4. Would you use it if it was available to you? - The average response was 7.4 out of 10.
5. Would you recommend others to use it? - The average response was 7.6 out of 10.
6. To what extent do you believe it will fill gaps of your existent knowledge? - The average response was 3.8 out of 10.
7. Could you obtain the information/knowledge provided by this material in another way? – The average response was 7.6 out of 10 showing that participants believed they could somewhat obtain the same information in other ways.
8. Do you think that the material successfully meets the purpose for which it was built? - The average response was 6.8 out of 10.
9. How useful would this material be for your university studies? - The average response was 6.2 out of 10.
10. How tedious is the material? The average response was 2 out of 10.
11. How complex and complicated is the material? - The average response was 1.6 out of 10.
12. How much load (memory and attention) does the material's use require? - The average response was 2 out of 10.
13. How satisfied are you with the use of this material? - The average response was 7.4 out of 10.

Math with Verbal Description

Scenarios

In the first task (Listen to mathematical equation 1 and repeat what you heard), all participants were successful. The average completion time was 28.8 seconds.

Participants	Success/Unsuccess	With/Without help	Time (sec)	Interruption for solution by himself, by help	Times of interruption
P1	S	With	25	help	0
P2	S	With	50	help	0
P3	S	With	56	help	0
P4	S	Without	3	himself	0

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P5	S	Without	10	himself	0

Table 142. First task from Math with VD

In the second task (Listen to mathematical equation 2 and repeat what you heard), all participants were successful. The average completion time was 25.6 seconds.

Participants	Success/Unsuccess	With/Without help	Time (sec)	Interruption for solution by himself, by help	Times of interruption
P1	S	Without	20	himself	0
P2	S	With	48	help	0
P3	S	With	49	himself	0
P4	S	Without	4	himself	0
P5	S	Without	7	himself	0

Table 143. Second task from Math with VD

In the third task (Listen to mathematical equation 3 and repeat what you heard), all participants were successful without help. The average completion time was 22.8 seconds.

Participants	Success/Unsuccess	With/Without help	Time (sec)	Interruption for solution by himself, by help	Times of interruption
P1	S	Without	18	himself	0
P2	S	Without	45	himself	0
P3	S	Without	40	himself	0
P4	S	Without	6	himself	0
P5	S	Without	5	himself	0

Table 144. Third task from Math with VD

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In the fourth task (Listen to mathematical equation 4 and repeat what you heard), all participants were successful without help. The average completion time was 21.2 seconds.

Participants	Success/Unsuccess	With/Without help	Time (sec)	Interruption for solution by himself, by help	Times of interruption
P1	S	without	15	himself	0
P2	S	without	40	himself	0
P3	S	without	35	himself	0
P4	S	without	9	himself	0
P5	S	without	7	himself	0

Table 145. Fourth task from Math with VD

In the fifth task (Listen to mathematical equation 5 and repeat what you heard), four out of five participants were successful without help. The average completion time was 19 seconds.

Participants	Success/Unsuccess	With/Without help	Time (sec)	Interruption for solution by himself, by help	Times of interruption
P1	S	Without	12	himself	0
P2	S	Without	35	himself	0
P3	S	Without	30	himself	0
P4	U	With	14	help	1
P5	S	Without	4	himself	0

Table 146. Fifth task from Math with VD

Semi-structured interview

The answers in the five questions are presented below.

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ΙΔΡΥΜΑ ΚΡΑΤΙΚΩΝ ΥΠΟΤΡΟΦΙΩΝ ΙΚΥ

1. We would like you to make a general comment on the material. How do you evaluate it (positive / negative)?

- Four participants evaluated the material positively while one evaluated it negatively.

2. What would you keep and what would you change about it? How (in which way) would you change each item you suggest for a change? Can you suggest some changes and improvements?

- All participants reported they did not have any changes to suggest.

3. Could you obtain the information/ knowledge provided by this material in another way? e.g., using some or a combination of some other alternative forms of educational material? What are they? (Should be listed individually or in combination).

- All participants reported they could obtain the same information with other means but none specified.

4. Where do you think this material would be helpful for you during your university studies (in which tasks / activities)?

- All participants reported that the material would be useful for their classes and studies in general.

5. What are the advantages and disadvantages of this form of material?

Based on the participants' responses, the main advantage of the material was the usefulness of the synthetic voice. One participant commented that the reading voice was great. The only disadvantage pinpointed by one participant was that they cannot add annotations to this type of material.

Usability Questionnaire

The questionnaire was completed by both participants.

1. How accessible is the material? – The average response was 4.4 out of 10 showing the material was not accessible for the participants.
2. How difficult was it for you to use it? - The average response was 4.2 out of 10.
3. To what extent is training required to be able to use it? - The average response was 1.4 out of 10.
4. Would you use it if it was available to you? - The average response was 2.6 out of 10.
5. Would you recommend others to use it? - The average response was 2.6 out of 10.
6. To what extent do you believe it will fill gaps of your existent knowledge? - The average response was 2.8 out of 10.
7. Could you obtain the information/knowledge provided by this material in another way? – The average response was 7.6 out of 10 showing that participants believed they could somewhat obtain the same information in other ways.
8. Do you think that the material successfully meets the purpose for which it was built? - The average response was 4.8 out of 10.
9. How useful would this material be for your university studies? - The average response was 4.2 out of 10.
10. How tedious is the material? The average response was 3 out of 10.
11. How complex and complicated is the material? - The average response was 2.6 out of 10.

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12. How much load (memory and attention) does the material's use require? - The average response was 2.4 out of 10.
13. How satisfied are you with the use of this material? - The average response was 3.4 out of 10 showing the participants were not satisfied with the material.

1.5. Conclusions

1.5.1. Individuals with Visual Impairments

MS Word Textbook

Participants preferred the MS Word textbook over all the others. According to them, MS Word has a lot of advantages: its familiarity, the fact that they already have ICT training for it, its straightforward shortkeys when working with NVDA, its editability (they mainly want to be able to keep just the parts they find helpful for studying for an exam in the file). Participants appreciated the contents and headings provided for the text. They gave the best evaluation in both the interview and questionnaire for MS Word.

PDF Textbook

Participants were initially negatively inclined to the PDF format. After exploring the material, the participants were pleasantly surprised by its level of accessibility and the ability to navigate it with familiar shortkeys similar to those they employ for MS Word. Participants mentioned that the PDF format is very common in university studies / higher education so making it accessible would be very useful and helpful for SwD. Nevertheless, there were issues with some Greek voices available for NVDA as the popular Greek synthetic voice "Stefanos" did not read the alternative text, but spelled it letter by letter.

DAISY Textbook

Participants knew of DAISY but were not familiar with it. Participants noted that training was necessary as they did not know how to explore this type of material on their own. Some participants thought DAISY was a fancy format of material when MS Word was more straightforward and more than covered their needs. Another disadvantage was the inability to edit the DAISY material.

ePub Textbook

Participants were ambivalent about the ePub textbook as it was not familiar to them and they had never received training for it, as they noted. Some participants liked its menu while others did not like its drop-down form. Another drawback was that, in some cases, the synthetic voices of the Thorium Reader and NVDA were activated at the same time.

MS Word Sample book

The participants preferred working with Word due to its accessibility features and familiarity. Verbal descriptions for images and graphs were considered crucial. The importance of starting each alternative text with the word "Picture" was highlighted as participants were confused when hearing terms such as graph or pie chart without first hearing that the pie chart was given in picture form. Participants expressed satisfaction with the book's design and content, appreciating its ease of use

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and accessibility features. However, dividing a file for a big textbook in smaller files for each chapter of the textbook was suggested in order to save time when navigating the book, especially if the intent is to study.

PDF Sample book

Participants were satisfied with the PDF sample book and its level of accessibility. Most participants were pleasantly surprised that a PDF file including complex material such as pictures could become so accessible. Participants appreciated the alternative text for pictures and the links for chapters in the contents. They also highlighted the importance of accessible PDF files as PDF is a popular file form in higher education that is easy to share. However, there were issues with some synthetic voices of NVDA which did not read the alternative text, but spelled it letter by letter. Participants also noted another disadvantage; that PDF files are not editable.

DAISY Sample book

The DAISY sample book was recognised as accessible in theory and as a form of material where complex content (text and image) can be incorporated. Due to its unfamiliarity, most participants found the navigation of this form of material hard. However, those participants that had more confidence in their ICT skills found that reading can be faster if you take advantage of the chapters / headings provided in the text.

ePub Sample book

The ePub sample book was recognised as accessible in theory, but most participants found it hard and complicated to navigate as it was an unfamiliar file form for them. Participants also noted that the content was not editable. Only one participant found the navigation to the headings and subheadings of the text to be fast and easy. Last but not least, it is noteworthy that two participants thought they could use this material more effectively with other software.

Power Point

Participants found the PowerPoint presentation very accessible and useful for their studies as a lot of professors use them during lectures. They also thought this material would be useful for oresenting their own work. Furthermore, participants reported that accessible presentations are hard to come across since the sighted prioritize the impressive design of their presentations over their functionality and consequently limit the access students with visual impairment have to their content.

Verbal descriptions

Participants found the verbal descriptions helpful and well written. One significant advantage of verbal descriptions was that they left no room for misinterpretations. Nevertheless, participants reported that they sometimes did not need or did not like so much information, something which was especially prevalent in long descriptions as the one for the map of the Empire of Alexander the Great.

Pictures in tactile microcapsule (piaf)

The images in tactile microcapsule were very well received by all participants. Participants thought that this type of material could be given to them as supplementary to texts used during their studies; for academic tasks, studying material or material for exams. An important advantage of this type of material was that it provides direct access to spatial information which could be confusing when provided verbally, such as the placement of objects. The main disadvantage of this form of material

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was the wear of the swollen parts of the paper with use. In addition, the distances between the dots of Braille were not optimal.

Tactile Tiger embossed prints

The participants showed a significant preference for the microcapsule prints compared to the tiger embossed material based on their comments. They found the Braille in this form of material more difficult to read even though the distances between the dots were similar and they also found less variety in the texture of the designs.

In both tactile microcapsule and tiger embossed prints, areas where lines met were difficult for participants to discern.

Audio-tactile pictures

The audio-tactile material impressed the participants since a lot of them were exploring it for the first time. The simultaneous access to textured designs and audio feedback gave instant access to information to the participants who commented on the superiority of this material. Nevertheless, participants recognised the need for someone to design the material and the price of the tablet as significant drawbacks.

Video

Participants found the video and accompanying text with its audio description useful. They reported that the text gave them the opportunity to create a mental picture of everything that took place on screen and that it was less tedious to listen to the natural voice of the video as a constant synthetic voice can be monotonous. However, some participants would prefer to have the audio description embedded in the video.

Math and Chem with MathML

The main advantage of the mathematical and chemical equations created with MathType was that they provided the participants with mathematical symbols of and the symbols of the chemical elements. As a result, they gave students with visual impairments access to the terminology that is used during their lessons and to which usually only sighted students have access to.

Math and Chem with VD

Participants found the verbal descriptions for mathematical and chemical equations very helpful, especially if they were not experts in the field and did not know the terminology or meaning of the symbols/terms. Furthermore, fewer punctuation mistakes of the synthetic voice were observed.

All in all, the study of both materials for Math and Chemistry showed the affordances of UDL and the importance of providing higher education students with the same material in different forms. The participants themselves reported different significant advantages for each type of material which could not be provided by the other.

1.5.2. Individuals with Mobility Impairments

MS Word Textbook

Participants appreciated the navigation pane of MS Word, the headings provided and especially the page icons which gave them fast and easy access while using an alternative mouse application. One

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participant also liked the size font. An MS Word textbook was recognised as being useful for lecture notes. One disadvantage was the page navigation bar.

PDF Textbook

Participants appreciated the hyperlinks provided in the contents of the PDF textbook. However, they were ambivalent on the easiness of navigating the pages of the PDF textbook. A drawback of PDF was its lack of editability. It must be noted that the position of the navigation menu on the right was observed to be advantageous to one participant based on their mobility characteristics. Consequently, the accessibility of a form of material was and is affected by the personal preferences and needs of each individual.

DAISY Textbook

The DAISY textbook was unfamiliar to all participants with MI. The accessibility of the material was generally recognised. Specifically, one participant appreciated the possibility to always have the navigation menu for chapters available when opening the program. However, participants found the navigation of this type of material hard which highlighted the importance of training.

ePub Textbook

Participants were unfamiliar with the ePub format. They evaluated it generally positively but found it to be in need of significant improvements. Participants would like to add visible page numbers to the text. Furthermore, the lack of editability was a disadvantage for them, while the progress bar and the available reading voice were both advantages.

1.5.3. Individuals with Hearing Impairments

Video with captions

Participants with hearing impairments found the video very useful for their studies and especially lectures with audiovisual components. The material would also be useful when noise does not allow them to take advantage of their remaining hearing. Even though the participants did not know or use sign language, they found the simultaneous presentation of captions and sign language in the same video useful and advantageous highlighting once again the benefits of UDL principles.

1.5.4. Individuals with Specific Learning Disabilities

MS Word Textbook

Participants appreciated the possibility of having a synthetic voice read the text for them and speeding up reading times, even though they did not like the quality of the voice. Participants with learning disabilities also appreciated the alternative text for visual content, the index and its editability. However, one participant found the alternative information provided superfluous. Furthermore, some participants did not like the speed and voice used with the NVDA for this study and find slower reading more beneficial.

PDF Textbook

Participants appreciated the possibility of having a synthetic voice read the text for them and speeding up reading times, even though they did not like the quality of the voice. Another participant

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found this format easy to download and print, but also noted its lack of editability which requires additional programs to be overcome.

ePub Textbook

Participants thought the ePub format is more usable. They appreciated the synthetic voice of the Thorium Reader the most as they believe it had better punctuation and slower speed than the voice of NVDA, as it was used in the study. However, one participant found that the search index did not work and another commented on the lack of editability of this format.

Power Point

Participants gave positive evaluations for the PowerPoint presentation. They again appreciated the possibility of having a synthetic voice read the content for them in spite of the quality of the voice. Two participants gave specific feedback for this type of material; they liked its easy handling and the possibility to read the content quickly as short text and few distracting elements were used in the presentation. The visual components helped one of them find the information quickly.

Math and Chem

Participants with specific learning disabilities had mostly positive feedback for both ways of presenting mathematical and chemical equations. As the participants with visual impairments, they also found unique advantages to each form of material. They appreciated having the names of the elements read by the synthetic voice when they were not experts in the field, but they wished they could add annotations to the material. Some participants recognised that this type of material would be especially useful for students with learning disabilities in specific fields of STEM.

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2. Appendix I

2.1. Visual impairments

1. Gender

a. Boy
b. Girl

2. The date of birth.

3. The place of residence

4. University

5. Department/ School

6. The type of your disability and the cause of it (official clinical diagnosis).

7. The age at onset of visual impairments.

8. Educational level

a. Undergraduate student
b. Post-graduate student (Master)
c. PhD student

9. Severity of disability

a. Blindness
b. Severe visual impairments
c. Moderate visual impairments
d. Low vision

10. What means do you use to read?

a. Braille or screen reader
b. Large prints or magnifiers

11. Visual acuity of the left eye

a. Total blindness, loss of light perception
b. Only light perception
c. Less than 1/20
d. Better than 1/20 and worse than 1/10
e. Better than 1/10

12. Visual acuity of the right eye

a. Total blindness, loss of light perception
b. Only light perception
c. Less than 1/20
d. Better than 1/20 and worse than 1/10
e. Better than 1/10

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13. Visual field

a. Full visual field
b. Central vision loss
c. Peripheral vision loss

14. You move alone or with the help of an attendant?

a. Alone
b. Sometimes alone and sometimes with help of an attendant
c. With help of an attendant

15. How often do you move alone?

a. Never
b. Few times
c. Some times
d. Most of the time
e. Always

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2.2. Mobility impairments

1. **Gender**

c. Boy
d. Girl

2. **The date of birth**

3. The place of residence

4. University

5. Department/ School

6. The type of your disability and the cause of it (official clinical diagnosis).

7. The age at onset of mobility impairments.

8. Educational level

a. Undergraduate student
b. Post-graduate student (Master)
c. PhD student

9. Your disability occurs

a. In your lower extremities
b. In your upper extremities
c. In your lower and upper extremities
d. On one side of your body
e. Only in one of your extremities
f. Other: _____

10. How would you most accurately describe the functionality of your hands?

(Select only one of the following answers)

a. I handle all objects easily and successfully. I may have some difficulties in activities that require great speed or/and accuracy. However, these difficulties do not restrict my independence in my daily activities at all.
b. I handle all objects with somewhat reduced quality (accuracy) or/and speed. Certain activities need to be done in alternative ways. Usually, these difficulties do not restrict my independence in my daily activities.
c. I handle objects with difficulty, I need help to prepare or modify the activities. My performance is slow and can be achieved with limited success as regards the quantity and quality of activity. I can be independent, only if the activities have been adapted for me.
d. I can only handle selected (very specific) objects that are easy and only in adapted activities. Usually, I only perform parts of an entire activity with a lot of effort and with limited success. I need continuous support, assistance and/or adapted equipment.
e. I cannot handle objects as I have severely limited ability to perform even simple actions. I need total assistance.

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11. You move alone or with the help of an attendant?

a. Alone
b. Sometimes alone and sometime with help of an attendant
c. With help of an attendant

12. How often do you move alone?

a. Never
b. Few times
c. Some times
d. Most of the times
e. Always

13. How would you describe your commute?

(Select only one of the following answers)

a. I walk on any place without restrictions and assistance. I may have balance, speed or motor-coordination difficulties.
b. In most places, I walk without any assistance. However, outside my home, I may use either walking aids – walkers, crutch, cane – for walking or climbing up the stairs or a wheelchair for long distances.
c. Most of the time, I need walking aids to be able to walk anywhere. Usually, I need the assistance of another person or I need specialized equipment to get up from the floor, from the bed, or from the chair. When climbing stairs, I usually need assistance or at least supervision from someone else. I need a wheelchair for outdoor environments.
d. Almost everywhere, I use a wheelchair on my own (either electric or manual wheelchair). However, almost always, I need the assistance of another person. Usually, I need special support on my torso (e.g., waist) and/or my head. I can walk at home for a while but only with the assistance of another person.
e. In all cases and in all places, I use a wheelchair. At best, I can use an electric wheelchair. I always need special support in my waist, torso and head. I use many types of assistive devices for mobility impairments, but I still need the assistance of another person.

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2.3. Hearing impairments

1. Gender

e. Boy
f. Girl

2. The date of birth

3. The place of residence

4. University

5. Department/ School

6. The type of your disability and the cause of it (official clinical diagnosis).

7. The age at onset of hearing impairments.

8. Educational level

a. Undergraduate student
b. Post-graduate student (Master)
c. PhD student

9. Do you have bilateral hearing loss?

a. Yes
b. No

10. Degrees of hearing loss in left ear

a. Slight hearing loss (25-40 dB)
b. Mild hearing loss (41-55 dB)
c. Moderate hearing loss (56-70 dB)
d. Severe hearing loss (71-90 dB)
e. Profound hearing loss (91+ dB)

11. **Degrees of hearing loss in right ear**

a. Slight hearing loss (25-40 dB)
b. Mild hearing loss (41-55 dB)
c. Moderate hearing loss (56-70 dB)
d. Severe hearing loss (71-90 dB)
e. Profound hearing loss (91+ dB)

12. **Level of difficulty in understanding the oral language (through lip reading)**

a. Very easy
b. Easy
c. Neutral
d. Difficult
e. Very difficult

13. **Level of difficulty in understanding the written language**

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a. Very easy
b. Easy
c. Neutral
d. Difficult
e. Very difficult

14. **Do you know sign language?**

a. Yes
b. No

15. **Do you use assistive listening devices?**

a. Yes
b. No

16. **If yes, which assistive listening devices?**

……(describe shortly)……

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2.4. Specific Learning Disabilities

1. **Gender**
    a. Boy
    b. Girl
2. **The date of birth**
3. **The place of residence**
4. **University**
5. **Department/ School**
6. **The type of your disability and the cause of it** (official clinical diagnosis).
7. **The age of diagnosis of learning disabilities.**
8. **Educational level**
    a. Undergraduate student
    b. Post-graduate student (Master)
    c. PhD student
9. **Level of difficulty in understanding the oral language**
    a. Very easy
    b. Easy
    c. Neutral
    d. Difficult
    e. Very difficult
10. **Level of difficulty in understanding the written language**
    a. Very easy
    b. Easy
    c. Neutral
    d. Difficult
    e. Very difficult

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