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Conceptualization and Evaluation of Guidelines
for Effective Disability Simulations
in the Context of a Digital Information Platform

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Stuttgart, 19.08.2024
Patricia Piskorek

Abstract (Deutsch)

Im Jahr 2021 gaben 15,9% der deutschen Studierenden an, dass ihr Studium durch eine Behinderung erschwert wird. Dies unterstreicht die Notwendigkeit, dass Hochschulen ihre Lehrmethoden anpassen, um Studierende mit Behinderungen zu unterstützen. In dieser Studie wird die Wirksamkeit von Behinderungssimulationen als Instrument zur Sensibilisierung von Hochschullehrenden für die Bedürfnisse dieser Studierenden untersucht. Während Simulationen von Behinderungen häufig kritisiert werden, weil sie möglicherweise negative Einstellungen fördern, zielt diese Forschung darauf ab, diesen Bedenken durch die Entwicklung von Richtlinien für effektivere Simulationen zu begegnen. Die Studie umfasst eine Literaturrecherche, eine Umfrage zu den Erfahrungen von Studierenden und die Entwicklung von drei verschiedenen Simulationsspielen auf der Grundlage der abgeleiteten Richtlinien. Die Spiele werden durch Benutzertests evaluiert, um ihre Auswirkungen auf das Lernen, die Empathie und das Engagement der Teilnehmer zu bewerten. Die Studie ergab, dass die Lernergebnisse effektiv erreicht wurden, wobei sich die Spielmechanik als erfolgreicheres Medium für die Wissensvermittlung erwies als textliche Erklärungen. Die Teilnehmer berichteten auch von einem hohen Engagement und fanden die Spiele einstimmig unterhaltsam. Allerdings zeigten nur wenige Teilnehmer ein gesteigertes Einfühlungsvermögen. Die meisten nahmen Studierende mit Behinderungen als weniger fähig wahr, typische Studiensituationen zu bewältigen, nachdem sie die Spiele gespielt hatten.

Abstract (English)

In 2021, 15.9% of German students reported having conditions that made studying more difficult, which highlights the need for universities to adapt teaching methods to support students with disabilities. This study explores the effectiveness of disability simulations as a tool for sensitizing university teaching staff to the needs of these students. While disability simulations have been criticized for potentially fostering negative attitudes, this research aims to address these concerns by developing guidelines for more effective simulations. The study involves a literature review, a survey of student experiences, and the development of three different simulation games based on the derived guidelines. The games are evaluated through user testing to assess their impact on participants' learning, empathy, and engagement. The study found that learning outcomes were effectively achieved, with gameplay mechanics proving to be a more successful medium for knowledge transfer than textual explanations. Participants also reported high engagement, unanimously finding the games enjoyable. However, only a few participants showed increased empathy. Most participants perceived students with disabilities as less capable of managing typical study situations after playing the games.

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1 Introduction

In 2021, 15.9% of German students reported having a condition that made studying more difficult. The reported impairments include hearing and visual impairments, mobility impairments, learning disabilities, chronic illnesses, mental health conditions, and other disabilities (Steinkühler et al., 2023). When university teaching staff must anticipate the presence of students with disabilities in their courses, it is crucial for them to adapt their teaching methods and materials to meet these students' needs. This is not just a considerate approach but a legal obligation: According to the "German Framework Act for Higher Education" ("Hochschulrahmengesetz"), §2, Paragraph 4, universities "must ensure that students with disabilities are not disadvantaged in their studies and that they can make use of the university's offerings without external assistance as far as possible" (translated from German) (Germany, 2019).

To effectively address students with disabilities, teaching staff must first be sensitized to their needs. Besides traditional resources such as books, websites, or presentations at training sessions and conferences, simulations are a tool frequently employed in the context of disability education and have been since at least the 1970s (French, 1996). Disability simulations place participants without disabilities in situations designed to help them experience what it is like to have a disability, albeit temporarily and under artificial conditions. There are both analog and digital simulations of various impairments. They target a broad range of audiences, including students, professionals working with people with disabilities, and product designers. The rationale is that experiencing the perspectives of others is often believed to be more impactful than conventional teaching methods.

However, as long as disability simulations have existed, they have also faced criticism. The most common critique is the lack of evidence supporting the effectiveness of disability simulations (French, 1996; Flower et al., 2007). In fact, some studies suggest that disability simulations can have negative rather than positive effects on participants. Specifically, rather than improving understanding and empathy, they may foster negative attitudes toward disabled people (French, 1996; Flower et al., 2007). After participating in disability simulations, participants in related user studies often reported feeling uncomfortable, confused, and incompetent (Nario-Redmond et al., 2017). When asked to assess the capabilities of people with disabilities — such as whether they could live and work independently — the participants often perceived individuals with disabilities more negatively than control groups did (Silverman et al., 2015). This is partly because disability simulations primarily emphasize the challenges and failures associated with newly acquired disabilities, instead of strategies and adaptations (Silverman et al., 2015).

While some researchers have called for the outright rejection of disability simulations (French, 1996; Brew-Parrish, 2004), others have made cautious recommendations on how these simulations might be redesigned to achieve the desired positive effects. This study aims to extract these recommendations from the literature and translate them into concrete guidelines.

Games that incorporate these guidelines are developed with the intention of integrating them into an existing digital information platform for university teaching staff. Through these games, the following research questions shall be addressed:

- Is it possible to implement all these derived guidelines simultaneously?
- Are these guidelines applicable to simulations of different impairments?
- Do these guidelines produce the desired positive outcomes?

To achieve this goal, a literature review is conducted to identify relevant primary sources on the topic of disability simulations. This literature review is supplemented by a survey of students who share their personal experiences with disability simulations. Based on these findings, guidelines are derived and described in detail. Special attention is given to how these guidelines should be adapted for the specific application case, which is a digital information platform for university teaching staff.

Existing simulation games are analyzed to determine whether they already implement these or similar guidelines.

Three games are then developed based on the guidelines, each addressing a different type of impairment. This process follows an iterative design approach with a feedback loop in the form of a pre-study. Additional ideas for simulation games targeting other impairments are outlined to suggest broader applicability of the guidelines.

To evaluate the games, and thus implicitly the guidelines, a user test is conducted. The test aims to assess the impact of the games on the players, specifically focusing on:

- How participants rate the attractiveness of the games,
- Whether participants acquire theoretical knowledge through playing the games,
- Whether participants develop empathy for students with disabilities through playing the games.

To measure the attractiveness of the games, the User Experience Questionnaire (UEQ) is used, as this standardized questionnaire is known for its high validity. To measure theoretical learning outcomes, knowledge questions specific to the games are generated. Empathy is assessed using a 7-item Likert scale, adapted from a study design by Silverman et al. (2015) for the purposes of this research. All quantitative measures are complemented by qualitative

interview questions posed to the participants.

The results of the user test are discussed with experts in the field of accessibility during a workshop and are ultimately interpreted in this thesis. From these discussions, research suggestions for future studies are generated.

This study documents the entire process of creating the games.

2 Methodology

The aim of this work is to design, implement, and test disability simulation games with a positive impact, specifically tailored for the context and target group of the BlindDate platform. The specific research question as well as objectives that are deliberately not pursued in this work are explained in chapter 4.3.

Firstly, a literature research is conducted to identify relevant papers on the topic of disability simulations. In addition, teacher students are asked about their experiences with disability simulations. Based on these results, guidelines for the creation of effective digital disability simulations are derived.

Several existing games are analyzed to see whether they implement the guidelines. In addition, three original game prototypes are developed that implement the guidelines. One of the prototypes is presented to members of the study population in a pre-study. After a subsequent revision of the prototypes, they are implemented programmatically.

The planned evaluation method is tested for its ability to produce meaningful results in a test run and adapted accordingly. Afterwards, the three games are evaluated by teaching staff. A post-evaluation of the results is done with experts from the field of accessibility. In this context, possible further research is discussed as an outlook for this study.

2.1 Details on the Research

The literature research aims to identify relevant papers from which the advantages and disadvantages of disability simulations can be recognized and corresponding guidelines can be derived. They are laid out in detail in chapter 4.1.

The literature review is conducted using a contextual "snowball approach" rather than a systematic method. This approach is chosen to identify primary sources and to obtain an overview of the topic. The research is conducted primarily through the platform "Semantic Scholar"[1] using the keywords "disability simulation". However, not all results of this search are examined, and some papers are obtained from colleagues via other platforms. Only English-language papers are included in the review, while the publishing date of the papers is not a criterion for inclusion.

As additional research, a group of teacher students for German secondary schools are asked about their experiences with disability simulations in order to review the notion of the research on disability simulations in practice. In the context of a presentation, in which the BlindDate platform is introduced to the students, an open discussion round is held thereafter. The results are described in chapter 4.2.

[1] https://www.semanticscholar.org/

2.2 Details on the Implementation

The initial game prototypes as used in the pre-study are implemented in Figma[2], a web application for creating prototypes in the field of user experience and user interface design. These prototypes outline the later games with moderate accuracy. The texts have already been finalized, however, some of the images used are still mock-ups. The game mechanics are modeled in the form of linear processes that the test users can click through, with no real user interaction or choices.

For the programmatic implementation of the games, the JavaScript programming language is used with the Svelte[3] software library. Svelte provides a framework to create reactive user interface components and is chosen to ensure that the games can be easily integrated into the BlindDate platform, which is based on the same technology. Contrary to the principles of BlindDate, the games are deliberately not created to be accessible in accordance with WCAG, which is due to their specific game mechanics. For the user study, these finished games are used.

The games all implement the guidelines, while fitting into the context of BlindDate both thematically and in their target group approach. More about the game design and implementation of the games is described in chapter 7.

2.3 Details on the Evaluation

One of the game prototypes is presented to members of the study population in a pre-study. This is done to rule out problems in understanding or operation that could interfere with the actual impact evaluation. Based on the given feedback, the prototypes are subsequently revised as illustrated in chapter 8.1.

The planned evaluation method is tested in a trial run. This is done to figure out if it can produce meaningful results and if it is of an appropriate length of time. To do so, the complete user study is carried out under realistic conditions with one test subject. Some of the survey questions are slightly adapted afterwards, which is explained in detail in chapter 8.2.5.

The evaluation aims to determine the impact of the games on the player, in regard to their acquired knowledge, their gained empathy, and their overall impression of the games. It is carried out with teaching staff, as they form the target group of the BlindDate platform. Each test subject plays two of the games and fills out an accompanying questionnaire, partly before and after play. Both quantitative and qualitative measures are gathered, using pre-

[2] https://www.figma.com/
[3] https://svelte.dev/

existing as well as self-designed questionnaires. Specifics of the user study are explained in chapter 8.2.

This work is discussed with experts from the field of accessibility in a post-evaluation in the course of a workshop at the ICCHP 2024 conference[4], to identify possible further research as an outlook for this study. The experts are presented with both the derived guidelines and the concrete results from the user study, and asked to reflect on both, using a quantitative poll and a qualitative discussion. This is further discussed in chapter 8.3.

3 Context

The following work is realized for and as part of the project "SHUFFLE" and its product "BlindDate", and intends to be integrated into both. This includes limitations such as the use of predefined programming languages, the incorporation of existing content as a basis, or the addressing of a given target group.

3.1 SHUFFLE

The SHUFFLE[5] project is a joint project between Stuttgart Media University, which is the consortial leader, Bielefeld University, and the Heidelberg and Freiburg Universities of Education. The name is an acronym for the German phrase "Hochschulinitiative digitale Barrierefreiheit für Alle", which translates to "University Initiative Digital Accessibility for All". The SHUFFLE project runs from August 2021 to December 2025 and is funded by the "Stiftung Innovation in der Hochschullehre" ("Foundation for Innovation in University Teaching"). The project is supported by an interdisciplinary team with professors, doctors, and research assistants from various departments such as computer science, special education, and ethics (SHUFFLE, 2024).

The SHUFFLE project recognizes that although digitalization can be helpful in everyday university life, it can also create new barriers for certain groups of people. The project therefore supports "equal opportunities for participation in digital teaching for students with individual needs" (translated from German)(SHUFFLE, 2024). In twelve different work packages and on a technical, structural, and didactic level, the partners are developing and testing "measures for equitable participation in digital teaching"(SHUFFLE, 2024), with the overarching goal of "systematically improving the current situation of digital accessibility at German universities"(SHUFFLE, 2024). All results of the project are made available to the public free of charge and open source.

[4] https://www.icchp-aaate.org/
[5] https://shuffle-projekt.de/

3.2 BlindDate

BlindDate[6] is being designed and implemented as part of the sixth work package of the SHUFFLE project. It is a German-language, digital information and meeting platform that enables users to meet virtual students with individual needs in the form of personas.

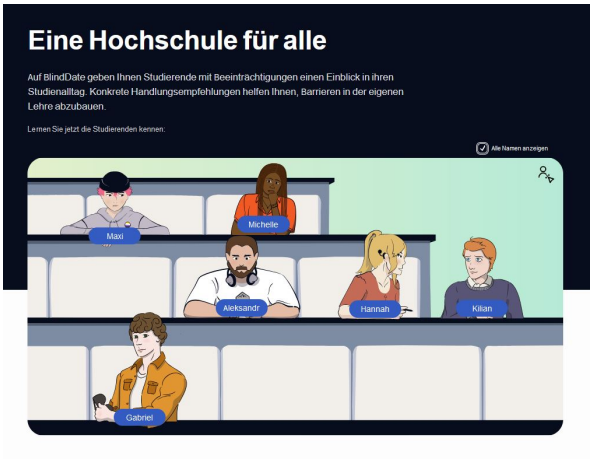


Figure 1: The BlindDate start page with the various available personas

Personas are fictitious individuals with specific characteristics. By representing a particular target group, they help to align the development process of a project with the needs of this group (Cooper, 1999). While personas are not real people, they are carefully constructed to be realistic and not simply invented. In the case of BlindDate, the data base for the personas is obtained through surveys, interviews, and co-design workshops with students with individual needs.

By identifying typical barriers in their everyday study life, as well as strategies for overcoming them, these personas are created to make users aware of students' individual needs and increase their empathy. Concrete recommendations for actions further help users to reduce accessibility barriers in their own teaching. BlindDate therefore is primarily aimed at university lecturers, with the goal to sensitize them to the needs of students and point out accessibility barriers in teaching.

The eight personas and their respective impairments that currently are or will be presented on BlindDate in the future are the following:

- Gabriel (visual impairment)
- Hannah (hearing impairment)

[6] https://barrierefreies-blinddate.de/

- Kilian (mobility impairment)
- Michelle (chronic illness)
- Maxi (mental illness)
- Aleksandr (neurodiversity)
- Oliver (learning disability) - *unfinished at the time of this work*
- Faiza (care responsibility) - *unfinished at the time of this work*

Each persona page begins with the name of the respective persona and a brief description of the general impairment, e.g. “Studying with visual impairment”. The “persona card”, which permanently scrolls with the user, provides more detailed information on the persona’s specific impairment, e.g. “Glaucoma”. Some keywords such as “screen reader” or “magnification” give a rough overview of the covered content presented on the persona page. Each persona introduces themselves and talks not only about their impairment, but also about their studies in general, their life situation, and hobbies. In this way, the personas are not reduced to their impairment. Each persona page provides information on the following topics, tailored to the current persona: Technologies and strategies, classes, learning materials, interaction and communication, and exams. Some of these are provided as quotes from the personas and their friends, others are neutral texts. Highlighted special terms can be clicked on to display a definition.

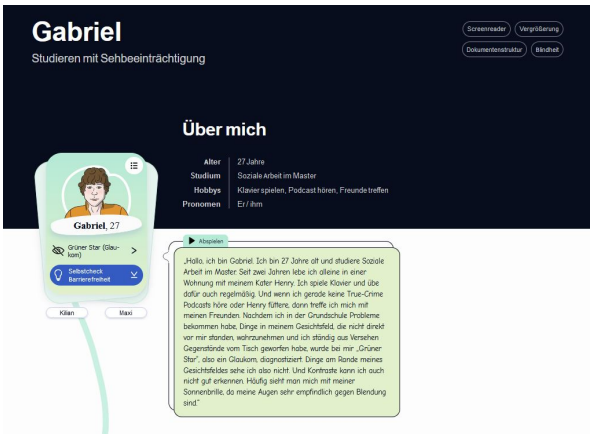


Figure 2: The beginning of Gabriel’s persona page

Different interactive elements can be found throughout the persona pages. These are created to give users a more varied way of engaging with the information. Some of these elements include:

- A puzzle with four pieces that give information about

what the persona thinks, says, does, and feels in a certain situation.

- A list of personal questions to the persona,
  which reveals the persona's answers when clicked on.
- A calendar that gives an insight into a typical week of the persona,
  in which certain situations can either go well or badly.
- A playing card that presents a stereotype about the persona,
  until one turns it over and sees the truth on the back.

Figure 3: The interactive puzzle

As an addition to the BlindDate platform, the idea is to integrate simulations as browser games, allowing teaching staff to experience a perspective shift by adopting the viewpoint of their students and enhancing the personas' immersion. However, there is uncertainty due to awareness of negative opinions regarding disability simulations.

The BlindDate platform serves as the primary source of the simulation games developed

in the context of this work, providing the personas with their names, images, and fields of study, as well as informational texts on the different disabilities. These components form the foundation from which the game content is derived.

While the BlindDate project and the aforementioned components involve a collaborative team effort, the simulation games are developed solely by the author of this work and in the course of this work.

4 Research

4.1 Research via Literature

4.1.1 Relevance

In 2021, 15.9% of German students reported having a condition that made studying more difficult. This was revealed by the latest "best3" study, which included 188,000 participants. Conducted every three years by the "German Center for Higher Education and Science Research" ("Deutsches Zentrum für Hochschul- und Wissenschaftsforschung", DZHW) and published together with the "German National Association for Student Affairs" ("Deutsches Studierendenwerk"), the study shows an increase from 11% in 2016, marking a rise of 4.9%. The reported impairments include hearing and visual impairments, mobility impairments, learning disabilities, chronic illnesses, mental health conditions, and other disabilities. Moreover, 59% of students with impairments reported that their condition significantly or very significantly affects their studies (Steinkühler et al., 2023).

When university teaching staff must anticipate the presence of students with disabilities in their courses, it is crucial for them to adapt their teaching methods and materials to meet these students' needs and ultimately reduce dropout rates. This is not just a considerate approach but a legal obligation: According to the "German Framework Act for Higher Education" ("Hochschulrahmengesetz"), §2, Paragraph 4, universities "must ensure that students with disabilities are not disadvantaged in their studies and that they can make use of the university's offerings without external assistance as far as possible" (translated from German)(Germany, 2019). The university's offerings here encompass not only the accessibility of buildings but all aspects of the study experience, including in-person lectures, online lectures, materials, excursions, laboratories, and websites.

To effectively address students with disabilities, however, teaching staff must first be sensitized to their needs. Besides traditional resources such as books, websites, or presentations at trainings or conferences, simulations are a tool frequently employed in the context of disability education. A brief experiment reveals that even ChatGPT, when prompted about

measures to raise disability awareness in the workplace, suggests[7] conducting simulations as one of the recommended approaches.

The rationale is that experiencing the perspectives of others is often believed to be more impactful than conventional teaching. Confucius is attributed with a statement that forms a basic principle of education to this day: "Tell me and I will forget, show me and I may remember; involve me and I will understand." As Bredemeier et al. (1981) note, "it seems plausible that experiencing the worlds of others would be more effective than traditional teaching methods" (Bredemeier & Greenblat, 1981). According to them, students "frequently mention the simulation-gaming experience as outstanding, report high satisfaction with the course, [and] express appreciation of knowledge gained about simulation-gaming as an instructional technique" (Bredemeier & Greenblat, 1981), although the reasons for these outcomes remain unclear to them.

4.1.2 Definition

A simulation is defined to create a representation of elements of reality. In this context, participants "carry out functions associated with their roles and with the settings in which they find themselves. The outcomes of the simulation are not determined by chance or luck. Instead, participants experience consequences that follow from the actions" within the simulation (Hertel & Millis, 2002, quoted from: Burgstahler & Doe, 2004). Consequently, a disability simulation places participants without disabilities in situations designed to help them experience what it is like to have a disability, for a limited time and under artificial conditions.

Disability simulations target a broad range of audiences, including students, professionals working with people with disabilities, and product designers. As further discussed in chapter 4.1.4, their primary objectives include serving as a resource to enhance skills and knowledge related to disabilities, as well as fostering empathy among participants.

Disability simulations have been employed since at least the 1970s. Morris (1976) utilized simulations of visual impairment as a training tool for professionals working with visually impaired individuals. This training involved various activities in settings such as classrooms and kitchens (Morris, 1976, quoted from: French, 1996). Similarly, Chaffin and Peipher (1979) implemented a simulation of moderate hearing loss as part of a training program for care workers assisting hearing-impaired children. Participants engaged in everyday tasks such as shopping, working, and dining, while experiencing the simulated hearing loss (Chaffin & Peipher, 1979, quoted from: French, 1996).

[7] https://chatgpt.com/share/f2112ddc-ed8f-4d8a-8423-2a87c6bd5c7b

Analog simulations like these are still conducted in a similar manner today, albeit now complemented by the availability of digital simulation technologies.

4.1.3 Types

Analog Simulations 1: Do It Yourself

One common method of analog disability simulation involves the use of simple household items. Numerous online and printed sources provide instructions for these simulations. For example, Brew-Parrish (2004) outlines such methods in her blog post, citing the "Disability Awareness Activities" booklet from the "Indiana Governor's Planning Council for People With Disabilities":

"All Thumbs"
Materials: Masking Tape, Raisins, Nuts, Pudding.
Activity: Sometimes people with physical disabilities don't have good muscle control. With masking tape, tape together the fingers of the participant's weaker hand, leaving only the thumb free. Give each participant a cup of raisins or a dish of pudding to eat using only that hand. Divide participants into pairs. Let one in each pair feed the other a dish of pudding. Trade places (Indiana Governor's Planning Council for People With Disabilities, quoted from: Brew-Parrish, 2004).

Using everyday items like scarves to blindfold the eyes, headphones to cover the ears, or tape to stiffen the joints of a participant, these simulations aim to mimic the characteristics of disabilities. The instructions are often targeted at teachers who then implement them with their students for teaching purposes. However, these simulations are also utilized in internally organized sensitivity workshops for professionals or at public events such as trade fairs. In these simulations, visual impairments, hearing impairments, or mobility impairments are most commonly simulated. Aging is also frequently simulated using a combination of these three.

Analog Simulations 2: Ready Made Kits

A similar scope in terms of simulated impairments and target audience can be achieved by using specially manufactured materials rather than household items. Unlike household items that can be repurposed for simulations, these ready-made kits typically include items specifically created to mimic the experiences of individuals with disabilities, designed to

provide a potentially more accurate simulation of various disabilities. They are sometimes, but not always accompanied by instructions for conducting disability simulations.

These materials have been available for a considerable time. French (1996) reported on the "Understanding Disability Training Pack" for schools, provided by the "Understanding Disabilities Educational Trust". The promotional materials for this kit promised that children would be "educate[d] about disability and change attitudes towards disabled people in a positive direction" while also having "great fun" (Understanding Disabilities Educational Trust, quoted from: French, 1996).

The production of such materials constitutes an entire professional field. A quick Google search using the keywords "Set zur Simulation von Beeinträchtigung" ("disability simulation set") in German yields results that vary widely in both reputability and price.

An example of a particularly low-priced set includes five simulation glasses designed to represent various eye diseases such as glaucoma, cataracts, or macular degeneration. These glasses are made of cardboard, with plastic lenses printed with black spots. In addition to being recommended for informational events, as previously mentioned as a target group, these glasses are suggested for use by doctors and their patients to illustrate disease progression. The set costs €9.[8]

Figure 4: Example of simulation glasses

An example of low credibility is a pair of glasses designed to simulate the effects of drug-induced alterations in environmental perception. The website promoting these glasses contains numerous spelling and grammatical errors in German.[9]

An "AgeSuit" claims to be "the perfect way to simulate aging" (translated from German)

[8] https://www.perspektrum.de/p/set-simulationsbrillen-augenkrankheiten-5-verschiedene-brillen

[9] https://preventika.com/de/p/103-cannabisbrillen-ertze-kontakt.html

and "proven for years". With the aim to provide "a vivid understanding of the lives of older adults", it is primarily intended for use by healthcare and caregiving professionals who need to learn how to interact with elderly individuals, as well as for industries developing age-appropriate products. The suit is designed to "promote empathy" through a "perspective shift" and includes various components to simulate different aspects of aging: Mufflers to simulate hearing loss, visors with opaque films to simulate visual impairments, as well as weights, bandages, and gloves to simulate mobility restrictions. The suit is available to rent or for purchase, starting at €895 for the Compact version, with Basic and Premium versions also offered. According to the website, clients include institutions such as Charité Berlin, University Hospital Freiburg, University Hospital Jena, University Hospital Saarland, as well as companies like Ford, BMW, Bosch, and Siemens.[10]

Figure 5: The "AgeSuit"

A similar suit from another manufacturer[11] claims to have its efficacy validated through studies. According to the manufacturer's website, the age simulation suit has been shown to realistically represent age-related impairments and is considered an effective tool for simulating the limitations associated with advanced age. Their evidence further indicates that

[10] https://agesuit.com/

[11] https://www.produktundprojekt.de/alterssimulationsanzug/wirksamkeit.html

empathy for elderly individuals is enhanced through the use of the age simulation, which demonstrates the suit's effectiveness as a teaching and learning instrument. However, there is no way to review the studies directly, as the only available information is the testimonial provided.

Several similar sensationalistic websites can be found, promoting their simulation products with bulk discounts and summer sales.

A different approach to disability simulation kits is exemplified by the "Blindheit Verstehen" ("Understanding Blindness") action kit[12] from the Christoffel-Blindenmission, an international development organization for people with disabilities. The materials included in this kit do not focus on simulating the impairment itself but rather on demonstrating assistive devices used by individuals with visual impairments.

The kit is designed for students aged 6 and up and is intended for use in schools and youth groups. It includes games such as "Ludo," "Domino", and "Memory", which have been tactilely adapted for the sense of touch, as well as an acoustic soccer ball. Although it also contains blindfolds to simulate visual impairment while playing these games, this is not the primary focus. The kit further includes a guide with practical tips.

Analog Simulations 3: On-Site-Events

In several locations across Germany, there are museums known as "dialogue museums" ("Dialogmuseum") that offer an immersive experience of blindness. These tours are recommended for adults as well as children starting from the second grade. Visitors, grouped in small teams of up to eight people, are guided through a completely darkened exhibition space for 60 minutes by visually impaired individuals. The tour features different themed rooms that simulate everyday situations, such as crossing a street.

This approach allows for a role reversal where blind individuals become the experts. According to visitor testimonials, initial feelings of pity transform into respect as the focus is placed on human potential rather than limitations.

The blind guide remains with the group throughout the experience. They are trained to ensure the visitors' safety and to foster a sense of trust. Visitors are further assured that they can exit the exhibition at any time if they feel uncomfortable and will be safely escorted back to a lit area.

In the museum's anniversary flyer, it is claimed that 74% of visitors report a change in their attitude toward blind individuals after their visit, and 76% still recall the experience

[12] `http://wheelymum.com/ich-sehe-was-was-du-nicht-siehst-aktionskoffer-zu-den-themen-sehbehinderung-und-hoerbehinderung/`

five years later. In the actual moment of the tour, simply having fun is the heart of the experience for many visitors.[13]

A different approach is taken by offerings such as "Dinner in the Dark". The provider investigated for this work offers this experience at 16 locations across Germany, although other providers exist. The focus is on the culinary experience, which is said to be perceived more intensely without the sense of sight. These events' aim is not to simulate life with blindness or to address barriers. It is unclear whether strategies for eating are presented, however, according to experience reports on the website, this is likely not the case. The tagline is: "Escape the stress of everyday life for an evening. Give your sense of sight a break."[14]

Digital Simulations 1: Digital Assistance

In the digital realm, numerous programs have been developed to assist individuals with disabilities in their daily lives. One example is "Seeing AI"[15], an application that utilizes the phone's camera to scan the surroundings, analyzes the visual data through artificial intelligence, and provides auditory descriptions of what is observed. While such applications can be used by non-disabled individuals to gain an understanding of the experience of having a disability, their primary purpose is not to simulate disabilities but to offer practical assistance. Consequently, these applications are not discussed in detail here.

Digital Simulations 2: Digital Media

The digital simulation of disabilities begins with the use of basic digital media. For example, there are videos and audio files designed to simulate auditory or visual impairments.

The organizing bodies of Germany's "Week of Vision" ("Woche des Sehens") have produced a series of short films. These films depict how individuals with various visual impairments experience everyday situations. Each video presents the same everyday scenarios, but with different simulated visual impairments. The videos are accompanied by general information about the specific impairment, provided via a voiceover narration.[16] A video by "Little Moving Pictures" simulates progressive hearing loss, eventually reaching a point where viewers would have to rely solely on lip-reading the individuals speaking in the video.[17]

Similarly, audio tracks from various sources illustrate to listeners how dialogues sound with

[13] https://dialogmuseum.de/
[14] https://www.das-dark-dinner.de/dinner-in-the-dark
[15] https://www.seeingai.com/
[16] https://www.youtube.com/watch?v=-FVCWx_XaKE
[17] https://vimeo.com/148127830

Figure 6: Example scene from the "Week of Vision" video

hearing impairments or when using hearing aids. There are also downloadable programs that allow users to create such audio tracks themselves by distorting any uploaded audio file to simulate specific hearing impairments, such as the "Cochlear Implant Simulator" from the University of Granada, Spain.[18] [19] [20]

Digital Simulations 3: Browser Plugins

Browser plugins like Chrome's "Web Disability Simulator"[21] or silktide's "Accessibility Simulator"[22] allow users to experience how individuals with various disabilities navigate and perceive websites. By temporarily altering the websites' CSS and content, these simulators create an immersive environment that mimics the challenges faced by individuals with disabilities. Since they operate within the browser, they can be applied to any desired website.

The simulated disabilities primarily include visual impairments like color blindness or tunnel vision. By simulating these conditions, developers can better understand how their design choices, such as colors and contrasts, affect usability for people with visual disabilities. Additionally, these simulators also cover mobility, reading and writing difficulties, and concentration issues. For example, since mobility issues can affect a user's ability to interact with web elements, such as buttons and forms, the plugins can simulate difficulties with mouse movement.

The Web Disability Simulator provides users with additional textual information upon selecting a specific simulation. This includes a brief description of the impairment being simulated, as well as concise tips for designing websites to be more accessible for individuals

[18] https://soundcloud.com/user-861258119/standard-classroom-low-level-chat-hearing-loss/s-Wx758

[19] https://ais.southampton.ac.uk/cochlear-implant/cochlear-implant-sound-like/

[20] https://www.ugr.es/~atv/web_ci_SIM/en/ci_sim_en.htm

[21] https://chromewebstore.google.com/detail/web-disability-simulator/olioanlbgbpmdlgjnnampnnlohigkjla?pli=1

[22] https://silktide.com/toolbar/

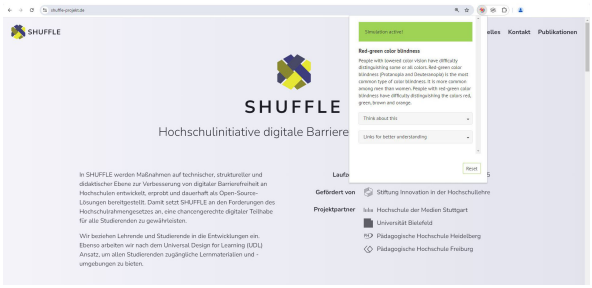


Figure 7: The Web Disability Simulator in action on the SHUFFLE project website

with that particular disability. Similarly, the Accessibility Simulator displays statistics on the average number of people affected by the selected impairment.

It is important to note that these tools are originally made for designers and developers who wish to test their websites for accessibility, particularly those who already possess some knowledge of accessibility practices. The creator of the Web Disability Simulator states that the goal of the tool is "to increase understanding and lower the threshold to test accessibility on a website".

Digital Simulations 4: Games

A significant portion of digital disability simulations is represented by games, which are implemented using various technologies such as virtual reality (VR), augmented reality (AR), or as browser-based games. Some games use impairments, such as limited vision, as gameplay mechanics, without aiming to simulate the actual experience of the impairment. While the distinction can be difficult, these types of games are not considered in this discussion in much detail. The remaining games that do focus on simulating disabilities vary significantly in how realistically or abstractly they depict them.

Extended Reality In the realm of extended reality, one example game is "You Are Being Followed"[23], which allows players to explore the world from the perspective of a blind woman and her guide dog. The game uses an abstract art style to depict the world as the visually impaired protagonist imagines it, based solely on what she hears. Another example is "Gravitational"[24], set in a distant future where a scientist in a wheelchair faces not only the challenges of his research but also his personal life story. These games offer diverse approaches to simulating disabilities, blending realistic experiences with more imaginative or

[23] `https://store.playstation.com/de-de/product/EP4592-CUSA11844_00-YABFABERTAY00000`
[24] `https://store.steampowered.com/app/1392690/Gravitational/`

abstract interpretations.

For the 10th anniversary of the death of German footballer Robert Enke, the Robert Enke Foundation launched the project "Impression Depression"[25] in 2019. This initiative aims to represent the thoughts and experiences of individuals suffering from depression. Using a VR headset, the project demonstrates various symptoms of depression, such as lethargy and worrying, within both everyday and competitive sports contexts. The VR experience begins with an introductory segment that provides participants with information about depression, as well as instructions on how to use the VR equipment. Following the VR experience, participants are required to take part in a mandatory reflection phase where they discuss their impressions of the VR experience. This phase also includes information on depression prevention. After touring Germany, the VR experience is available for booking by companies, universities, and other institutions.

Traditional Games The BlindDate simulations fall within the category of browser-based games that users can play independently and individually. Taking a specific impairment, such as depression, as an example, it becomes evident how varied the approaches to game design for these simulations can be.

One sub-category is interactive comics. An example of this is the game "Actual Sunlight"[26]. The core element is text that presents the character's thoughts - harsh, somber self-reflections - accompanied by minimal imagery and music. There is no real gameplay in the sense that players cannot influence the course or outcome of the story. Instead, they navigate the narrative by clicking through the story, becoming witnesses to unpleasant decisions. The experience is heavily text-based, and players gain insights only if they read thoroughly, rather than skimming through the content.

Games like "Depression Quest"[27] advance further towards a genuine gaming experience, incorporating interactive elements. It is a choice-based game where players make decisions based on presented scenarios. The situation of the depressive character is described in detail from a second-person perspective, including specifics such as the day, time of day, and weather. The game provides insights into what the character has done earlier in the day, what they are currently doing, and then presents choices for what they might do next. Some options are crossed out and unavailable based on the character's current state of depression. The severity of the depression impacts the number of choices available, with more limited options corresponding to more severe depressive states. This game is also heavy on text,

[25] `https://impression-depression.de/`
[26] `https://store.steampowered.com/app/288040/Actual_Sunlight/`
[27] `http://www.depressionquest.com/`

emphasizing a narrative over complex gameplay mechanics.

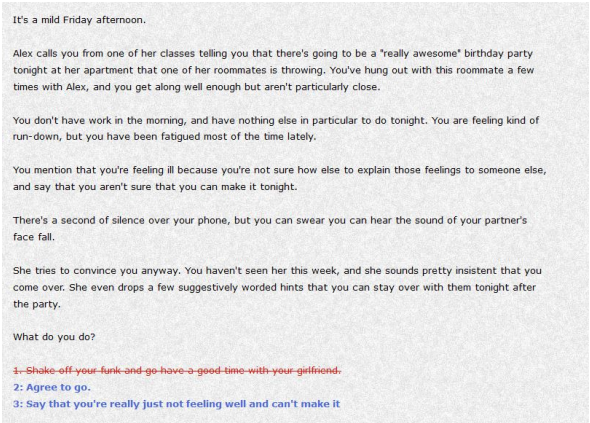


Figure 8: The "Depression Quest"

Other games place a strong emphasis on visuals. For example, exploration games such as "Depression: The Game"[28] and "Please Knock on My Door"[29] are point-and-click games where the player interacts with various objects in the environment while playing as a depressive character. These games feature voiceovers and internal dialogues characterized by self-loathing, creating an atmosphere that portrays a dull life.

Another approach to simulating depression involves the abstraction of the theme. Examples of this are side-scrollers like "Elude"[30] and "Limbo"[31]. In "Elude", different areas of the game world symbolize different emotional landscapes. Players first navigate through a bleak environment, gradually moving towards a higher, happier state. However, no matter how well they perform, they inevitably fall back down into the unhappy state. The game models the experience of depression by contrasting it with other mood states, portraying depression metaphorically.

The example of depression is used here to illustrate the wide variety of game types available for simulating different impairments. Similar diversity exists for other disabilities as well. Several games will be analyzed in detail in chapter 6.

[28] https://store.steampowered.com/app/881920/Depression_The_Game/?l=german
[29] https://store.steampowered.com/app/613450/Please_Knock_on_My_Door/
[30] http://gambit.mit.edu/loadgame/summer2010/elude_play.php
[31] https://store.steampowered.com/app/48000/LIMBO/

Figure 9: The side-scroller “Elude”

4.1.4 Aims

On the basis of the previously discussed types of disability simulations, we can summarize their goals as follows.

The primary objective of simulations is to create a learning activity that enables participants to develop skills, gain knowledge, or change their attitude toward the simulated reality (Hertel & Millis, 2002, quoted from: Burgstahler & Doe, 2004). These simulations are reputed, though not universally verified, to change perspectives and increase empathy (Bredemeier & Greenblat, 1981).

Disability simulations, in particular, aim to achieve several specific objectives:

- **Enhancing Empathy:**
  Disability simulations are often designed to help non-disabled individuals, especially students, gain a deeper understanding of the challenges faced by people with disabilities. This experience can foster greater empathy, compassion, and respect for the diverse needs and perspectives of individuals with disabilities.
- **Training Tool:**
  Simulations can serve as training tools for professionals who work with people with disabilities. For example, teachers, healthcare providers, social workers, or police officers may use these simulations to better understand the experiences of people with disabilities and improve their interactions and support strategies.
- **Inspiring Innovation:**
  Disability simulations can inspire and motivate individuals to pursue innovative solutions that enhance accessibility and the quality of life for people with disabilities. Experiencing the benefits of accessible design and assistive technology firsthand may encourage participants, such as software designers, to implement changes that benefit the disability community.

Despite these potential benefits, it is essential to critically examine whether disability simulations truly achieve these objectives.

4.1.5 Critique

The age of some of the relevant papers (e.g. Bredemeier & Greenblat, 1981; French, 1996) highlights how long this topic has been discussed and, equally, how long disability simulations have been subject to criticism. In 1996, French criticized the lack of evidence of the effectiveness of disability simulations, pointing out that, at that time, no research paper positively demonstrated the "value of exercises which simulate disability" (French, 1996). By 2007, this situation had not improved, as Flower found in a meta-study on the topic. Out of the originally identified papers, 61% were excluded due to a lack of empirical data, leaving only ten papers. These remaining studies showed only minimal to negligible positive effects (Flower et al., 2007).

Conversely, French's literature review suggested that disability simulations might even have negative consequences for participants. Specifically, they could teach negative, rather than positive, attitudes towards disabled people (French, 1996). Flower et al.'s findings pointed in the same direction: Although not statistically significant, six out of seventeen effect sizes measured were negative (Flower et al., 2007).

In 2015, Silverman et al. effectively demonstrated and explained this negative effect. In a study involving 153 university undergraduate students, participants were divided into groups to assess the impact of disability simulations. Some students then performed tasks while blindfolded, such as walking through a lab, filling a glass with water, and sorting coins. They received no known assistance during the simulation. The control groups performed these tasks without any disability or simply observed another player in a disability simulation (Silverman et al., 2015). Despite receiving detailed third-person knowledge about the entire simulation process, the results of those who observed others playing the simulations did not differ from the control group, which did not experience any simulation. An effect was noticeable among participants who directly experienced the simulation, and it was negative. When participants were subsequently asked to evaluate the abilities of blind individuals, participation in the simulation worsened the participants' perceptions, leading them to view blind people as less capable of living and working independently (Silverman et al., 2015).

Similar results were found by Nario-Redmond et al. (2017). The research team discovered that students participating in a disability simulation felt more uncomfortable, confused, and incompetent after the simulation, as well as embarrassed and guilty. They were also more worried about potentially becoming disabled themselves (Nario-Redmond et al., 2017).

Individuals who participated in Silverman et al.'s disability simulation further anticipated that their own abilities would be significantly restricted if they were blind. They predicted that their adaptation to blindness would be slower and less complete over time. Participants believed they would not be able to manage their life as it is now if they became disabled (Silverman et al., 2015).

This occurs because participants are thrown into the simulated situation unprepared (Bauer, 2020). Disability simulations primarily emphasize the challenges and failures associated with newly acquired disabilities (Silverman et al., 2015), highlighting the initial negative experiences and focusing excessively on difficulties (French, 1996). Burgstahler et al. (2004) articulate it aptly: "Participants learn how difficult it is to maneuver a wheelchair, how frustrating it is to be unable to hear or read, how frightening it is to be visually impaired, or how impossible it is to participate in activities without the use of their hands. They focus on what people with disabilities cannot do rather than on what they could do with appropriate access, technology, or skills" (Burgstahler & Doe, 2004).

French (1996), who has a visual impairment, explains that they do not experience the problems that participants in some studies faced (French, 1996). However, disability simulations typically do not address the strategies and skills disabled people develop in living with impairment, nor the competencies and adaptations of being disabled (French, 1996). Even then, in the short time given, there is no opportunity for a participant to fully learn strategies to succeed (Burgstahler & Doe, 2004). Ultimately, this feeling of initial overwhelm is projected by the participant onto disabled individuals (Silverman et al., 2015).

On a few occasions, participants might develop the mindset that people with disabilities are inspiring or remarkable because they manage life despite their impairments (Brew-Parrish, 1997; Brew-Parrish, 2004).

Oftentimes, however, disability simulations lead to a diminished perception of the capabilities of people with disabilities (Silverman et al., 2015), ultimately reinforcing damaging stereotypes and misconceptions (French, 1996). Then, pity is a possible outcome of disability simulation experiences (Brew-Parrish, 2004; Bauer, 2020). In the blog of Raul Krauthausen, Bauer (2020) states that future interactions with people with disabilities are likely to be characterized not by respect, but by feelings of superiority (Bauer, 2020). When participants emerge from the simulation feeling grateful for not having a disability (Krauthausen, 2015), they may conclude that having the ability to walk, speak, or hear is preferable to using a wheelchair or sign language, perceiving their own abilities as inherently superior (Krauthausen, 2017).

Ultimately, these negative feelings solely reflect the negative perception that able-bodied people have of those with disabilities, not the real experience of being disabled (French, 1996).

This can have long-term consequences: People with disabilities may be less likely to live and work independently, not because they are physically unable to, but because socioeconomic prejudices limit their options (Silverman et al., 2015).

Lack of Strategies

In 2017, Silverman et al. addressed these issues again in a study and achieved improved results when simulating paraplegia and hemiplegia with 32 students. The study's goal was to teach participants how people adapt to physical impairments. The activity was intentionally designed to allow students to complete the tasks with minimal difficulty while providing instructions on coping techniques and assistive devices. For example, when tasked with making a sandwich, students used an angled knife and a cutting board with corner guards, rather than conventional utensils. After the simulation, students were more likely to perceive people with disabilities as happy and healthy, unlike the control group. One student noted that the experience was "a good way to get people thinking about the challenges that a person with a disability may face, but at the same time remind them how incredibly functional and adaptive people with a disability are" (Silverman et al., 2017).

This suggests that the tools and guidance provided during the simulation had a significant impact on the students' perceptions, demonstrating the potential for simulations to foster a more positive understanding of disability when designed with a focus on adaptation and strategies of people with disabilities. Silverman emphasizes that the learning outcome for disability simulations should be that "being disabled is challenging, yet adaptable" (Silverman et al., 2015).

Ultimately, disability simulations should adopt a solution-oriented approach (Bauer, 2020), ensuring that participants avoid focusing exclusively on the challenges imposed by a disability (Burgstahler & Doe, 2004). Instead, accommodation strategies should be explored by using concrete examples for overcoming barriers faced by people with disabilities, demonstrating how they cope with inaccessible environments through technology and interpersonal skills (Burgstahler & Doe, 2004). Additionally, this approach portrays aids and assistive technologies as liberating rather than limiting (Krauthausen, 2015).

Lack of Environment

A second improvement for disability simulations, frequently highlighted in the literature, is to shift the focus away from individual impairments. Simulations often emphasize the disability itself rather than addressing the barriers that contribute to the disability (Krauthausen, 2017; Bauer, 2020). Instead, the focus should be on how society can be changed to reduce or

eliminate disability (French, 1996). Participants should be encouraged to explore the design of resources and environments that minimize barriers for people with disabilities and examine how well-designed environments can maximize access for everyone (Burgstahler & Doe, 2004).

For example, simulating the experience of navigating a web page using a text-to-speech system can demonstrate the challenges faced by people who are blind. However, "if the simulation ends without discussing how web pages can be designed to be accessible to visitors who are visually impaired, participants could be left with the notion that the disability causes lack of access" (Burgstahler & Doe, 2004). In addition to highlighting potential solutions as previously discussed, it is equally important to analyze the construction of the problem (Burgstahler & Doe, 2004). This can extend to having participants examine their own role in both causing and addressing the problem (French, 1996).

The approach aligns with the ongoing societal shift of paradigms away from the medical model of disability. Instead, social models, as well as universal design, argue that barriers are created by inaccessible design choices made by designers (Burgstahler & Doe, 2004; Degener, 2009).

Lack of Realism

Another aspect of criticism addressed in the literature is the lack of realism in disability simulations. French (1996) notes that simulations often fail to accurately represent impairment (French, 1996).

If the content of a simulation does not authentically reflect the reality it aims to portray, participants might still find the game enjoyable, but are unlikely to learn the intended lessons (Bredemeier & Greenblat, 1981). Inaccurate simulations do not provide participants with meaningful insights into the actual experience of disability (Burgstahler & Doe, 2004). However, without an accurate depiction of reality, no genuine knowledge gain occurs (Krauthausen, 2015).

In addition to a realistic representation of the disability itself, the context in which the barriers are portrayed should also be realistic (Krauthausen, 2015). Furthermore, the quantity and severity of the barriers in the simulation should be balanced to avoid exaggeration (Bauer, 2020).

Lack of Participation

To ensure the simulation's authenticity, people with disabilities should be actively involved in the conceptualization process (Bauer, 2020; Burgstahler & Doe, 2004).

Referring back to the recommendation that simulations should demonstrate strategies,

Silverman et al. (2015) suggest to at least provide opportunities for participants to observe how disabled individuals competently perform tasks. However, they argue that enabling direct contact between disabled and non-disabled people would be even more beneficial (Silverman et al., 2015). Hearing directly from individuals with lived experiences of disability can deepen participants' understanding of the challenges people with disabilities face, and more importantly, how these challenges can be effectively addressed (Burgstahler & Doe, 2004). This approach fosters empathy. Additionally, through interaction with people with disabilities, learners may realize that some of their assumptions about disability are unfounded (Burgstahler & Doe, 2004).

Therefore, including people with disabilities not only in the conceptualization, but in the actual execution of simulations is an approach worth considering (Bauer, 2020; Burgstahler & Doe, 2004).

An integration of people with disabilities into educational efforts about disabilities is advocated even by authors who fundamentally oppose simulations. French (1996), for example, insists that people with disabilities should lead training sessions, while Brew-Parrish (1997) suggests that they demonstrate their strategies to non-disabled people (French, 1996; Brew-Parrish, 1997).

Other Aspects

It is noteworthy that criticism of disability simulations predominantly stems from authors who themselves have disabilities, such as Silverman, Krauthausen, French, Brew-Parrish, and Doe (co-author of Burgstahler). In contrast, most simulation exercises are planned and executed by non-disabled individuals.

None of the aforementioned researchers advocates for typical disability simulations in their current form. As previously mentioned, some researchers like French (1996) and Brew-Parrish (1997) completely reject these simulations altogether (French, 1996; Brew-Parrish, 1997). Other researchers, such as Burgstahler et al. (2004), concede that "carefully designed simulations are effective learning tools in specific situations" (Burgstahler & Doe, 2004).

Conclusively, disability simulations can be considered acceptable, but only if they adhere to specific directives. These directives encompass the previously discussed points, along with several additional ideas proposed by various authors:

- **Choice of Participation:** Burgstahler et al. (2004) suggest that participants should be given the option to decline participation in simulations, allowing them to simply observe if they are reluctant to fully engage. This prevents forced or resentful involvement, which can diminish the educational value of the experience (Burgstahler & Doe,

2004).

- **Avoidance of Comparisons:** It is essential to avoid comparing experiences of different disabilities to prevent participants from making statements such as, "I could never live with [one disability], but I could handle [another]" (Burgstahler & Doe, 2004).
- **Expression of Assumptions:** Participants should be encouraged to openly discuss their personal assumptions about disabilities, including negative ones, without fear of repercussions. This helps in understanding the underlying thoughts that might drive discriminatory practices (Burgstahler & Doe, 2004).
- **Communication of Objectives:** According to Burgstahler et al. (2004), it is crucial to clearly communicate to participants at the beginning of the simulation what they will be doing, why it is important, and what they are expected to learn (Burgstahler & Doe, 2004). However, Bredemeier et al. (1981) counters this perspective, arguing that "much if not all of the point of the simulation-gaming experience would be lost if participants knew the point in advance" He states that the learning outcomes are often determined by variables beyond the instructor's control, and that much of the simulation's value lies in participants discovering insights on their own during the experience (Bredemeier & Greenblat, 1981).
- **Provision of Debriefing:** According to Burgstahler et al. (2004), a thorough and meaningful debriefing is important to help participants process the emotional aspects of the simulation and to consolidate what they have learned. This should include discussing their feelings, reframing new knowledge, and addressing any unanswered questions (Burgstahler & Doe, 2004). However, Bredemeier et al.'s (1981) literature review indicates that the effectiveness of debriefing can vary. He notes that the quality of the discussion may be a critical factor influencing its outcomes and that different simulations might have varying needs for debriefing (Bredemeier & Greenblat, 1981).
- **Highlighting of Commonalities:** Krauthausen (2015) advocates for demonstrating that non-disabled individuals also encounter barriers, thereby emphasizing the universal nature of challenges (Krauthausen, 2015).
- **Showcasing of Enjoyment:** Krauthausen (2015) also emphasizes the importance of conveying the enjoyable aspects of living with a disability, such as the fun elements of wheelchair sports, to counterbalance the typical focus on difficulties (Krauthausen, 2015).

Limits

Ultimately, disabilities should not be treated as events through simulations. Such events convey a sense of spectacle: Participants want to win, while observers want to witness their struggles. The simulation experience becomes a competition to overcome as many barriers as possible. However, if there are "winners" and "losers" in this context, it implies that people with disabilities must simply exert more effort in their daily lives (Bauer, 2020; Krauthausen, 2015).

Additionally, what cannot be simulated are the social and psychological challenges faced by people with disabilities (French, 1996). The reality of people with disabilities also includes isolation from social life due to inaccessibility (Krauthausen, 2015) or prejudice, unemployment, and resulting poverty. Disability simulations do not capture these cumulative effects of encountering barriers over a lifetime (French, 1996).

However, authors with disabilities also emphasize that in typical simulations, the positive aspects and non-struggles of living with a disability are neglected (Bauer, 2020; French, 1996). While there are challenges associated with living with a disability, these are often contextual and do not encompass the entirety of a person's life experience (Burgstahler & Doe, 2004).

4.2 Research via Survey

In an open group discussion, 15 teacher students for German secondary schools were asked about their experiences with disability simulations. This was done as additional research and to further review the opinion on disability simulations in practice. The discussion was held on May 16th, 2024, and took about 30 minutes. Before the discussion, the students had been introduced to the BlindDate platform and its interactive elements via a presentation.

Firstly, the students were asked:

- "Have you ever taken part in disability simulations?"
- "In what context was that?"
- "What did you like? What did you dislike?"

Their statements were noted down, but not commented on.
Afterwards, the students were encouraged to generate their own ideas for disability simulations in small groups. Guiding questions were:

- "Which impairments can (not) be simulated?"
- "What positive or negative learnings could participants gain from your simulation?"

Five of the students reported on their own experiences with simulations. It is not known whether the other students have not yet had any experiences with disability simulations or have not shared them.

- One student describes how, in training for their driving license, they put on glasses designed to simulate being drunk. They thought it was “funny”.
- At a holiday camp, another student was guided through the grounds while blindfolded, including a walk through a stream. They mentioned needing “a lot of trust” in other people.
- During their studies, a student teacher for physical education experienced a simulation involving various physical impairments. They wore a fatsuit, blindfolds, and gloves, and breathed through a straw, all while doing sports. They realized ”how well [they were] doing without impairments”.
- Only one student participated in a typical wheelchair course. When difficulties arose, they were pushed from behind. They commented that people in wheelchairs “have a hard time”.
- Lastly, one student remembered wearing a plaster cast after having broken a bone. Reflecting on this period, they remarked being “lucky that it was only for a few weeks”.

Their own ideas for creating disability simulations included the following:

- One team proposed that hearing impairments are the easiest impairment to simulate. They suggested using headphones to cancel all noise or to play specific sounds such as a ringing in the ears to the test subjects. Their hypothetical goal was to convey the notion that having a hearing impairment is exhausting. Additionally, by allowing the test subjects to put themselves in the position of people with hearing impairments, the group wanted the test subjects to learn how to better interact with them.
- Another group collected ideas on how to simulate ADHD or autism. They observed that it is impossible to lower the human brain’s filter. That is why they wanted to artificially increase stimuli instead. Their hypothetical goal was to see what it “does to the test subjects” to live with a constant overload. Additionally, they mentioned that the test subjects might find ways to deal with the stimuli throughout the simulation.

Towards the end of the discussion, one student suggested that simulations can also have negative consequences. They argued that simulations only cover a short time frame, whereas people with disabilities face them throughout their lives. Consequently, they suggested that test subjects should always reflect on the fact that the experience is not real.

In summary, the survey confirmed the criticism found in the literature regarding disability simulations. One student found the simulation they took part in amusing, indicating a lack of seriousness in their experience. The other participants all reported negative emotions, expressing pity for people with disabilities and relief that they themselves were not disabled. These participants further believed that the primary objective of a simulation should be to convey how difficult it is to live with a disability. Only after an extended discussion, participants began to consider that such a simulation could also teach how to better interact with people with disabilities or how people with disabilities manage situations in daily life.

4.3 Research Questions

This work is a documentation of the development process of simulation games for the BlindDate platform. Based on the literature review and the survey conducted, it aims to establish guidelines for developing digital simulation games intended to have exclusively positive effects, i.e. fostering an understanding of disabled people's needs and capabilities, and to ultimately apply these guidelines specifically to games for the BlindDate platform and its target group.

The research questions include

- whether it is possible to implement all derived guidelines simultaneously,
- whether these guidelines are applicable to different simulated impairments, and
- whether the guidelines produce the desired positive outcomes.

The study does not aim to conduct comprehensive disability research and focuses solely on data obtained from the BlindDate platform. Consequently, no validation will be performed with students with disabilities as represented by the personas. The disadvantages of common disability simulations will not be analyzed, as these can be deducted from the literature. Instead, potential positive effects of the games designed following the new guidelines will be highlighted. Furthermore, it is not the aim of this work to propose alternatives to disability simulations.

5 Derivation of Guidelines

In the following chapter, the critique from the literature is transformed into constructive recommendations.

The content of this chapter was initially introduced in a more concise form as part of a paper for the AAATE 2023 conference (Piskorek et al., 2023). However, this work provides

a more detailed and comprehensive exploration of the topic, expanding on the initial ideas presented in the earlier work.

As discussed and widely agreed upon by multiple authors, the following directives can be derived from the literature and will serve as a foundation for the development of own guidelines in the next step:

- **Focus on Strategies:** It is essential to provide practical strategies for participants to explore how people with disabilities accomplish tasks. This solution-oriented approach demonstrates that with these strategies, tasks can indeed be completed, emphasizing the adaptability of people with disabilities.
- **Focus on Barriers:** It is crucial to emphasize barriers. Instead of focusing on the disability itself, simulations should prioritize the social model of disability by highlighting the barriers that create difficulties and exploring what changes can be made to help people with disabilities apply their strategies more effectively.
- **Focus on Realism:** Another key point is maintaining realism in simulations. The disability being simulated should not be abstracted. Moreover, the context in which barriers are presented should be realistic, with a balanced portrayal of the quantity and severity of these barriers to reflect real-life challenges accurately.
- **Focus on Participation:** It is vital to ensure the participation of people with disabilities in both the creation and execution of simulations. Their involvement enhances the realism of the experience, fosters empathy and understanding, and helps reduce prejudices through direct interaction. By being demonstrated strategies in practice, participants can see that these methods are, in fact, effective.

Guidelines for BlindDate

In the case of BlindDate, which embeds digital and asynchronous disability simulation, specific guidelines need to be further tailored for this particular format.

The focus on strategies can and should be adopted as a core aspect. The purpose of simulations in any setting should be to improve participants' perceptions of people with disabilities, which is achieved by highlighting adaptations. This is also true for BlindDate. However, this approach is particularly important in an asynchronous setting, because participants do not have the immediate support or the opportunity to have their misconceptions corrected that would be available in a live or synchronous environment.

The focus on barriers is beneficial. In the context of BlindDate, it aims to demonstrate to teaching staff how they can support students with disabilities. However, this focus is

integrated within the broader strategy-oriented framework, as the emphasis on barriers helps to identify the conditions necessary for students to effectively apply their strategies. Without a clear presentation of strategies, the focus on barriers becomes less meaningful.

The focus on participation should be considered during the development of the simulations. While further incorporating participation in the execution of the simulations may seem challenging in a digital and asynchronous setting, even a fictional, virtual presence of a person with a disability can be beneficial. This approach aids in building empathy, effectively conveying the lived experiences of individuals with disabilities. Thus, the simulation feels more authentic and less like a game.

The demand for realism in digital disability simulations must be moderated. Digital game mechanics, which are experienced through a screen and a mouse, cannot fully represent all forms of impairment realistically. While some abstraction is necessary and acceptable, it is crucial to acknowledge to the participant that such abstraction is part of the design. It is still important that the context of the simulation remains realistic. The game narrative should depict a plausible everyday scenario where barriers appear.

In a digital format, as on BlindDate, an additional focus on tasks should be incorporated. When simulations are implemented as games, the game itself needs a clear objective or goal. While this may seem to contradict the approach of not turning disabilities into events, as it introduces elements of "winning" or "losing", this concern is mitigated by the fact that players are alone at their computer, without direct competition or comparison to others. This solitary experience ensures that the focus remains on personal engagement and understanding.

The guidelines ultimately designed for the BlindDate application are encapsulated in Silverman et al.'s (2018) statement: "To be beneficial, simulations must include **guided** exposure to effective **methods** for completing daily **tasks** with disabilities" (Silverman et al., 2017).

These guidelines are:

- Task-Based
- Strategy-Based
- Guided

5.1 Guideline 1: Task-Based

The first guideline specifies that the user should be given a clear task to solve with the simulated impairment, as opposed to a free exploration of their current situation. While this

is already realized for many analog simulation events, where the task might be to finish a wheelchair parkour or sort coins while blindfolded, the guideline "task-based" is not implemented in specific digital applications: Browser plugins that allow the user to view arbitrary websites through the lens of a disability were primarily designed for developers with basic knowledge about accessibility, however, they can still be used by everyone.

The given task should be simple in nature. This way, the user experiences it more difficult as soon as they can no longer solve it at all or only with increased effort due to the simulated impairment. The user can also be asked to fulfill the task once before starting the simulation, i.e. without the impairment, in order to further increase the perceived contrast.

However, the task at hand should still be realistic. It can originate from Additionally, the task can be embedded in a short, relatable story or scenario that contextually describes the situation in which it could be performed. For example, the aforementioned sorting of coins is no poor choice for an analog task, as shopping and paying is a familiar activity for most people. In a digital setting, filling in forms during online banking could be a counterpart.

Ultimately, the guideline "task-based" ensures that the user navigates the simulation purposefully, rather than aimlessly, thus missing the intended goal. Instead, they experience a sense of achievement and pride.

Implications for BlindDate

To enforce the user to fulfill the tasks, the simulations on the BlindDate platform are developed as dedicated stand-alone applications ("mini-games"), which are then embedded into the different persona pages. Contextually, the tasks show typical situations from the everyday study life of the personas, which increases the users' immersion. Teaching staff who play the simulations might know the tasks from their own lives, as they are the ones who pose them to the students.

5.2 Guideline 2: Strategy-Based

To be able to experience the aforementioned feeling of achievement or pride, the user must be able to successfully complete the task. This is ensured by the guideline "strategy-based", which specifies that the user should be advised on how to navigate the situation with the simulated impairment.

This catalog of advice can include, but is not limited to experience reports, tips on the use of specific hardware or software, or actual assistive technology, encompassing the various strategies used by people with disabilities in their daily lives. For example, the user could be taught how to properly use a white cane in an analog, or a screen reader in digital blindness

simulation. By implementing this guideline, the main mechanic of the simulation shifts from simply encountering barriers due to disability, to overcoming them despite disability. The user learns that people with disabilities need not be pitied as they are capable of managing their everyday lives.

A possible second part of this guideline is to show the user what environmental factors can make it harder or easier to use the given strategies. For example, they can be presented with websites that are, in turn, poorly and well structured to be used with a screen reader. This way, the user is implicitly taught how they can assist people with disabilities in the future by making content accessible.

Ultimately, the guideline "strategy-based" gives the user an idea of the possible adaptation they would acquire over the years when living with the simulated disability.

Implications for BlindDate

The simulations on the BlindDate platform implement strategies that are explained on the respective persona pages as core game mechanics. By design, the given task becomes impossible to solve upon the start of the simulation. Once the strategy has been explained to the user, however, the mechanic of the strategy is unlocked, making the task solvable again. As the game progresses, environmental factors are changed so that it gets even easier to apply the strategy.

5.3 Guideline 3: Guided

The aforementioned strategies need to be explained to the user, in order for them to be able to efficiently use them. The presence of a person who can do just that is specified in the guideline "guided".

The guide who accompanies the user throughout the simulation should be a person with the simulated disability who is already well adapted to it. Then, the guide is the expert on their disability and can demonstrate to the user how they, in turn, can solve the given task with the given strategy. For example, the user will quickly realize how effortlessly a blind person can navigate a scene with their white cane.

Having a guide who shares the user's disability can foster a deeper understanding and connection, offering not only technical advice but also personal experiences or emotional support when the user struggles. While a real person is ideal for the role of the guide, a well-designed fictitious guide can also be effective, provided they are based on the insights of real individuals with disabilities.

Ultimately, by proposing their real-life strategies for solving tasks, a guide creates a transition between a purely fictional simulation and real-life experiences.

Implications for BlindDate

In the simulations on the BlindDate platform, the respective fictional persona whose disability is being addressed acts as the guide. They emerge after the user has been unable to solve the given task due to the simulated disability and describe appropriate strategies. Only then, the corresponding game mechanics are unlocked. Furthermore, the persona honestly explains a strategy's limitations, environmental influences that hinder its applicability, and the degree of realism of the simulation.

5.4 Design Pattern for BlindDate

By combining the three guidelines, a design pattern for the simulations for the BlindDate platform is created. Each simulation game consists of eight specific tasks of the same task type.

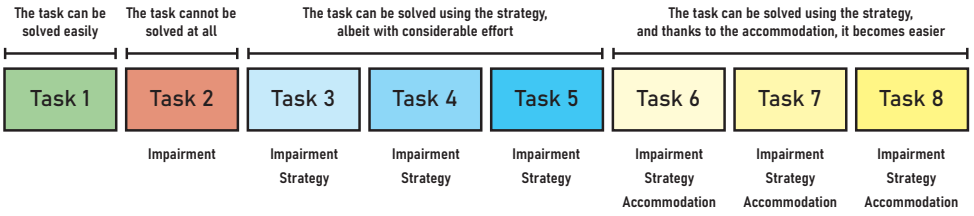


Figure 10: The Design Pattern for BlindDate

1. During the first task, the simulation has not started yet, and the user is fully abled in regard to the game mechanics. They are introduced to the scenario, e.g. the topic of the persona's lecture, and to the task at hand. They can solve it easily.
2. During the second task, some ability is taken from the user via the simulation. By game design, they now cannot solve the task at all. The experience is the one of being newly disabled with no adaptation.
3. During the third task, the persona comes to the user's aid. While they explain the strategy to overcome the barrier from their own experience, the corresponding game mechanics are unlocked. The user is now able to solve the task again, albeit slower and with more effort than in the beginning.

Having the user complete the task without any impairment in the first step enhances the perceived contrast to when they encounter the unsolvable task in the second step. Likewise, making the task entirely unsolvable - rather than merely difficult - in the second step enhances the perceived contrast when the task becomes solvable again in the third step.

From their first appearance during the third task, the persona is now continuously present and comments on the user's journey from their own point of view.

During the following two tasks, the experience of solving them using the strategy is deepened, with the game mechanics staying the same as before. Working under the same conditions for three tasks is comparable to a minimal adaptation of the user as they would normally acquire over the years. During the fourth task, the persona explains the strategy's disadvantages and limitations. During the fifth task, they explain what external circumstances would contribute to them being able to apply the strategy more efficiently.

6. During the sixth task, the task is altered to meet the aforementioned condition. Contextually, the persona's teacher has reduced barriers in their teaching. The user, despite the disability, is now able to solve the task with more ease.

The following two tasks again take place under the same conditions as the sixth. During these three tasks, the key learnings that BlindDate intends to communicate to its target group of university teaching staff are conveyed. By experiencing those themselves, the user gains an understanding of how they can support people with disabilities in their future teaching, enabling their efficient use of strategies with minimal accommodations.

6 Identification of Guidelines

In this chapter, existing games will be analyzed with respect to the previously developed guidelines. The analysis focuses on games that closely align with the scope of the BlindDate project: To maintain comparability, only browser games will be considered, excluding analog media, browser plugins, or XR experiences.
The analysis addresses two main questions:

1. Are the guidelines implemented in these games?
2. What additional insights for BlindDate can be drawn from these games?

This comparison helps to explore whether existing games have independently arrived at similar design principles and provides practical examples that could be adapted or improved upon in the BlindDate games.

6.1 Lola‘s First Semester

German title: Lolas Erstes Semester. A game[32] by studiumdigitale – Zentrale eLearning-Einrichtung der Goethe-Universität Frankfurt am Main

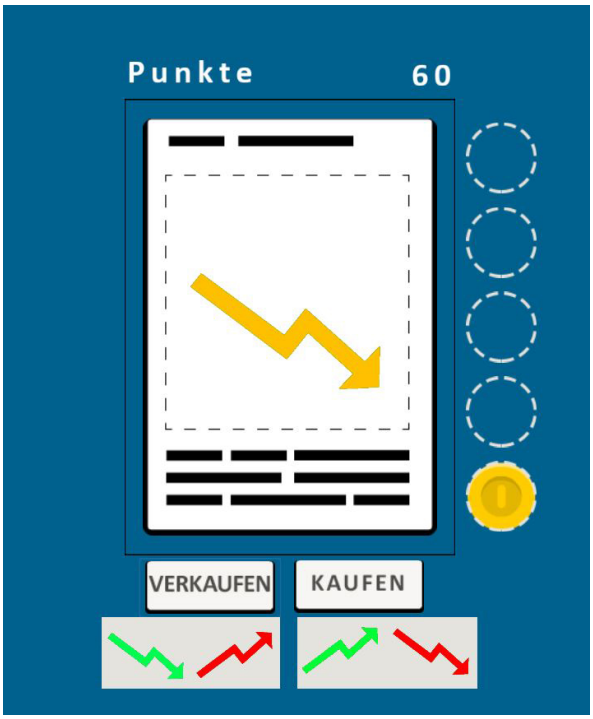


Figure 11: The Lola’s First Semester Game

Duration Approximately 30 minutes

Narrative The protagonist, Lola, is a first-year university student experiencing her first day at the university with some fellow students. This includes her attending a lecture, eating at the cafeteria, and starting a student job. From the outset, Lola’s visual impairment due to glaucoma is highlighted, and the player is briefly informed about its implications for her. According to the introductory text, the objective of the game is to familiarize players with various visual impairments.

Mechanics During the cutscenes, Lola engages in conversations with other people at the university. In these scenes, a drawn image of the person speaking is displayed alongside a speech bubble labeled with their name.

[32] https://lolaserstessemester.sd.uni-frankfurt.de/

When potentially unfamiliar terms such as "screenreader" are mentioned by any character, players are often given the option to have the character provide additional information on the topic. These dialogues can be skipped if the player is already familiar with the term and does not require further explanation.

The game primarily consists of various mini-games with distinct mechanics. At the beginning of each mini-game, instructions are provided to explain how to play. The minigames cannot be accessed individually. The game must be played linearly, replaying the entire narrative each time.

The first minigame is contextually integrated into a lecture scenario where students are given an assignment related to economics. Players must buy or sell stocks by clicking on corresponding buttons when either a green or red arrow is displayed. Initially, this task is straightforward. However, the perspective then shifts to Lola's classmate, Leo, who has red-green color blindness. From Leo's viewpoint, all arrows appear similarly yellow, forcing the player to guess the correct actions. Despite the challenge, correct guesses still earn points.

In another minigame, players have to remove barriers during an online lecture. Each potential barrier is represented by a phrase and an icon, such as "No Headset Connected" accompanied by a crossed-out headset image. Simultaneously, small, identical-looking ghosts move across the screen, which must be clicked to be chased away and thus remove the barrier. The game neither simulates nor explains why these elements constitute barriers.

Further minigames include adopting Lola's perspective to validate her student ID with a restricted field of vision, or making PDF documents accessible using again highly abstract tools.

Task-Based? The nature of the minigames requires players to complete tasks to successfully finish each game. These tasks are generally straightforward. In the game involving Leo's red-green color blindness, the difference in task difficulty is starkly illustrated: Initially, the task is easy, but it becomes significantly harder when performed with the simulated impairment. Conversely, the game where Lola validates her student ID does not include an initial phase where the task is performed without impairment.

While all tasks are contextually embedded in the narrative, such as Lola attending a lecture or visiting the cafeteria, the degree of realism of the tasks varies. The games on Leo's red-green color blindness and Lola's glaucoma depict everyday moments in a university setting, like lecture assignments or validating an ID. At the same time, these games provide a visual representation from the perspective of the impaired individual. In contrast, while participating in an online lecture is also a typical moment in a university setting, chasing away ghosts is a highly abstract task and lacks realism.

The core goal of the "Task-Based" guideline, which involves creating a sense of achievement, is not fully realized in "Lola's First Semester". Although players can accumulate points based on their effort in the minigames, these points have no tangible impact on the game's progression or outcome. The lack of meaningful rewards or consequences diminishes the feeling of accomplishment.

Strategy-Based? While players receive basic instructions on how to play the minigames, they are not provided with strategies to excel in them. This is particularly evident in the game about Leo's red-green color blindness, where players are left to guess. Ultimately, by design, this results in failure due to losing all lives, even after a few correct guesses. This aspect indicates a clear non-fulfillment of the "Strategy-Based" guideline. The game as a whole focuses more on making players experience various barriers rather than overcoming them. This approach further fails to demonstrate the adaptive strategies used by individuals with disabilities.

Guided? The primary role of a guide is to provide the player with strategies to navigate and overcome challenges. Since "Lola's First Semester" does not offer any strategies, this aspect of the guideline cannot be fulfilled, either. Despite the lack of strategic guidance, the game does feature characters with disabilities. They are virtual students, like Lola, Leo, and others. These characters frequently discuss the challenges posed by their disabilities, sharing relevant information and statistics. This helps players build empathy by fostering a connection with these characters and understanding their experiences.

Conclusion The game "Lola's First Semester" partially implements the given guidelines. A positive aspect is the presence of characters with disabilities acting as guides, which facilitates empathy development. However, the tasks vary in their realism. Some minigames are very realistic, allowing players to experience barriers firsthand. Others are overly abstract, primarily relying on reading associated texts to learn about the impairments. Furthermore, for a more user-friendly experience on BlindDate, it should be possible to access specific simulations directly, rather than requiring players to replay the entire game. This can be achieved either by allowing a level selection or by extracting the minigames from the overarching narrative context.

6.2 Blind to the Bus

German title: Blind zum Bus. A game[33] by Wildfuchs Interactive, produced for "Woche des Sehens"

Duration: Approximately 15 minutes

Narrative: In a fictitious dialogue, a blind person encourages a sighted person, who represents the player, to experience a day without vision. They plan a visit to a market together, which they will reach by taking a bus, all while blindfolded.

Mechanics: The game is designed to be playable completely without the need for vision. No critical information is displayed visually, instead, all instructions are delivered audibly. The game consists of several mini-games, which share some mechanical similarities. They are embedded within the overarching narrative of two people navigating their way to a bus while being blind. Players have unlimited attempts to complete each mini-game, meaning it is impossible to truly lose. Additionally, each level can be selected and played individually via a menu. Between the mini-games, there are audio-narrative sequences that describe events occurring to the two characters. These sequences subtly convey theoretical learnings. Moreover, the blind friend provides continuous guidance during the mini-games, explaining the objectives and mechanics.

In the first mini-game, the player searches for their keys in a messy drawer before leaving the house. This task, like all others, reflects a realistic daily situation encountered by everyone. The player must find the keys by moving the mouse across the black screen, listening to different sounds at each spot, and identifying the sound of the keys.

In the second mini-game, the player uses a fictitious white cane to follow a tactile guiding system and is required to stop by releasing the mouse button when they reach an attention field, signaled by a change in the sound.

Other games follow a similar structure, where players must detect differences in sounds. As the game progresses, the levels become increasingly complex and challenging.

Task-Based? Each mini-game serves the purpose of fulfilling a specific task with the simulated impairment. These tasks are realistic and drawn from everyday life, applicable to both blind and sighted individuals, such as searching for keys before leaving the house, crossing a street, or walking to the bus. Players do not initially perform the task without

[33] https://www.woche-des-sehens.de/spiel/blind-zum-bus

the impairment. However, because these tasks are so common, players can understand from their own experiences how easily they could be completed with their usual senses. All tasks are integrated into the game's overarching narrative.

The sense of accomplishment implied by the guideline "task-based" is ensured by allowing players to repeat the tasks as many times as needed. Failure is not possible, instead, with each attempt, players learn from previous mistakes and experience a form of adaptation. For the aforementioned reasons, the game can indeed be described as "task-based."

Strategy-Based? The game is implicitly strategy-based. Strategies such as the use of the white cane and tips on its application are available to the player, as required by the guideline. However, these strategies are provided right away, instead of given to the player within the course of the game. Thus, players can complete the tasks without becoming explicitly aware of the strategies‘ significance or importance, since they do not experience the contrast of attempting the tasks without them.

Assistive technologies like the white cane, tactile paving systems, and audible traffic signals are explained within the game. The tips provided are more focused on gameplay mechanics, such as instructing the player on which button to press to move the cane in the game, rather than offering a realistic understanding of how these tools are used in real life. This approach slightly reduces the realism of the simulation.

Environmental factors that could make the use of these assistive technologies easier or more challenging are not directly experienced through gameplay mechanics. Instead, they are occasionally discussed in the dialogues, providing a theoretical understanding rather than an interactive one.

Despite this, the player is able to notice that, after several attempts at the tasks, they become more adept at navigating the game. This improvement can lead players to project this increased competence onto real-life blind individuals, fulfilling the guideline's aim of highlighting the capabilities of people with disabilities.

Guided? In the game's introduction, the blind friend equips the player with a fictional white cane and explains that she will offer assistance and explanations along the way. She functions as a guide throughout the game, consistently providing the slightly abstracted tips needed for successful gameplay. Moreover, she integrates real theoretical knowledge about blindness in her talking, including how to interact with blind individuals, allowing the player to learn insights applicable to their own life.

While she does not demonstrate how quickly and effectively she can navigate situations compared to the player, the friend speaks to the player in a highly encouraging manner,

reinforcing their ability to succeed on their own. As she embodies a well-adapted blind person, she shares advice grounded in her own experiences. Her portrayal and the accompanying dialogues are both realistic and seemingly fact-based.

Conclusion The game effectively implements the guidelines, particularly in "Task-Based" and "Guided". While it initially appears that the guideline "Strategy-Based" might not be fully realized, since there is no noticeable difference in how tasks could be completed without the strategies, the guideline's objective is ultimately achieved. The player gains an understanding of how individuals with disabilities adapt, especially due to the opportunity to repeat tasks multiple times under the same conditions, which allows the player to experience adaptation firsthand. This is a valuable insight for BlindDate, suggesting that giving players the chance to perform similar tasks repeatedly under consistent conditions can enhance their sense of adaptation.

There is some uncertainty about whether the theoretical learnings delivered through the audio sequences will be as effectively retained by players, especially since listening might not be the most familiar method of information absorption for sighted players, who likely constitute the majority.

One critique is that the strategies presented in the game are based on analog tools that have been digitally abstracted for gameplay. It might have been more realistic to showcase digital technologies directly, avoiding the need for abstraction and providing a more accurate representation of the strategies used by individuals with disabilities.

6.3 Accessibility Maze

A game[34] by the G. Raymond Chang School of Continuing Education, Toronto Metropolitan University

Duration: Approximately 15 minutes

Narrative: The player embarks on a quest to find the mysterious "Accessibility Master" and uncover his secret to making the world fully accessible. For this purpose, the Accessibility Master has constructed a secret maze, through which the player must navigate to discover the secret.

Mechanics: The player controls a small character in a third-person view, navigating the maze using arrow keys, similar to typical "jump and run" gameplay. The player progresses

[34] https://games.de.torontomu.ca/amaze/

Figure 12: The Accessibility Maze Game

through various rooms of the maze, comparable to an escape game, with each door representing a puzzle related to one WCAG guideline. This game does not directly simulate disabilities, but abstracts the problem and makes it experienceable in a different context that initially seems to have nothing to do with disabilities.

For example, the code to the first door is the name of the Accessibility Master's cat. Within the maze, the player easily finds a photo of the cat with its name noted on the collar, however, the photo is obscured by ink stains. To decipher the name, the player has to discover the written version of the name on the back of the photo. Only after opening the door, the game explains the puzzle's relevance to accessibility - here: "Visual content must have a text alternative" - with an explanatory paragraph.

Other puzzles follow similar themes. The need to properly label buttons on a website is abstracted by physical buttons with worn-off letters that first need to be matched with an external sign in order to put in the code for this door. The need to be able to pause timed content is demonstrated when a lever to open a door needs to be frozen for it to remain in place long enough.

In the final room, the player meets the Accessibility Master, who states that "there is no magic that can make the world accessible. But there are things you and I can do to get closer to that goal." He then provides an "Accessibility Guide," a downloadable PDF explaining the WCAG guidelines featured in the puzzles with additional theoretical insights.

Task-Based? The game can be considered task-based, as the act of opening each door resembles a task. Players do not explore freely, instead, they have clear objectives.

The tasks are easy and the player effortlessly understands what must be done and what obstacles are present. For example, it is evident that the code for the first door is the

cat's name, and simply identifying this is not the primary challenge. Similarly, it is promptly understood that the name is inscribed on the collar, with the ink blots rendering it illegible. It is thus not necessary for the player to solve a similar task without the impairment beforehand. The problem is rooted in a familiar reality for the player, ensuring they are not thrust into an unfamiliar and incomprehensible scenario.

The tasks, although not realistic everyday activities of either the target or the represented groups, are made understandable and meaningful through the context of the game's story. The main goal of working on tasks is for the player to act purposefully and achieve objectives, which is what the game "Accessibility Maze" achieves despite its abstraction.

Strategy-Based? In-game strategies are designed to enable the player to solve the tasks set despite the simulated impairment. In the case of the "Accessibility Maze", aids such as the printed name of the cat, a sign with the names of the buttons and a freeze spray represent these strategies. However, just like the given tasks, they are strongly abstracted from reality. This means that no real assistive technologies, experience reports, or similar are presented here, and no theoretical learning takes place in this respect.

Players learn the basic concepts of accessibility barriers and solutions, although they do not experience how a person with disabilities actually perceives or navigates a website, e.g. using a screen reader to read alternative texts from images such as the cat's name. Still, the game emphasizes that barriers can be overcome and highlights the importance of considering environmental factors in the context of web design, thus conveying an abstract learning to players who work in the field of web design.

Guided? The guide has the objective of explaining the strategies to the player. In this game, this is done via the Accessibility Master's diary. The player reads an entry from this diary before each locked door. These entries explain the story behind each puzzle, such as water damage washing off the button labels, and describe the Accessibility Master's solution strategies, like creating an external sign with said labels. Thus, the Accessibility Master provides the player with his strategies, even if only implicitly through his diary.

The Accessibility Master is not a person with an impairment, but rather an expert for all impairments or, in the context of the story, for all problems with the doors in the maze. He can not help the player with their problems, as he is not present in person, but there is no need for him to do so, either, as the simplicity of the game ensures that no problems occur. While the Accessibility Master provides strategic insights, he does not bridge the gap between abstraction and reality with personal experiences, nor does he foster an emotional connection between player and guide that might enhance the player's perception of competence of the

portrayed group.

Conclusion Overall, "Accessibility Maze" largely implements the given guidelines. In terms of content, the game is aimed more at web designers who need to familiarize themselves with the WCAG guidelines. However, learning objectives for teaching staff could surely be structured in a similar manner.

The primary reason the game does not fully align with BlindDate's goals is its level of abstraction. BlindDate personas share personal stories from their academic experiences, and the embedded simulation games should be designed to deepen this immersion rather than step back from it.

7 Application of Guidelines

In this chapter, the previously derived guidelines are applied to the design of new games. This process aims to test whether the guidelines can be implemented simultaneously, thereby validating part of the research question. Additionally, the chapter explores designing games for different types of impairments to assess the suitability of the guidelines across various use cases.

The context of the games being integrated into the BlindDate platform has implications for the game design. The primary audience for these games is university teaching staff. Consequently, the games need to be concise, considering that teaching staff typically have limited time. The setting of the games should consistently revolve around the everyday university life of the personas, tailored to their specific fields of study. For instance, if a persona is studying mathematics, the game would feature math-related tasks and scenarios. The games' intended learning outcomes should provide practical insights that teaching staff can implement in their teaching practices.

The games are designed to be similar enough that they are clearly recognizable as part of the same platform. This consistency is maintained in certain design choices, such as the overall structure of the user interface. Even though it might be interesting to make changes in individual games, the global design consistency takes precedence over these decisions.

An abstraction of disabilities into playable mechanics is acceptable and, in the context of these games, a deliberate game design choice. This approach can still effectively convey underlying principles about strategies, and perhaps even enhance understanding, because it allows players to focus on the core challenges and adaptations rather than getting overwhelmed by the full complexity of the disability. However, it is important to inform the player that they are not experiencing a realistic representation of the disabilities.

One initial idea was to find justifications for the impairments in the player's realm, such as having their headphones stop working in the game about Hannah. However, this approach was ultimately not implemented because it could detract from the focus on understanding the challenges faced by individuals with disabilities and diminish or downplay the severity of these challenges.

Each game should be composed of the following components:

- **Task**
- **Impairment:** The impairment makes the task impossible to complete.
- **Strategy:** The strategy makes the task completable, albeit with effort.
- **Accommodations:** The accommodations make the strategy easier to apply.

To design each game, the texts from the BlindDate platform must provide information on at least one strategy and one form of assistance, which must be contextually related to create a narrative and gameplay experience. The primary game mechanics should be derived from the identified strategy. The tasks should be relevant to the academic daily life and field of study of the respective persona.

In the first step, strategies and accommodations mentioned in the BlindDate persona texts were extracted and analyzed. The goal was to identify which accommodations positively influence which strategies, as indicated in the lists below. This process was conducted for six of the eight personas, since two personas, namely Faiza and Oliver, had not been completed at the time of this work. The analysis was then used to determine feasible combinations of a strategy and an accommodation that could inspire game design ideas. In the following lists, the numbers in parentheses following the accommodations indicate which strategies of the personas they positively support.

Hannah's Strategies

Hannah's strategies to manage her hearing impairment.

What Hannah does:

1. Uses hearing aids
2. Uses cochlear implants
3. Uses sign language
4. Uses subtitles or other written forms of auditive content

What Hannah's teachers can do:

- Provide lecture materials early
- Avoid background noise during lectures (1, 2)
- Keep their mouth visible and do not turn away (1, 2)
- Use microphones connected to hearing systems (1, 2)
- Add and correct subtitles to their videos (4)
- Write everything on the slides instead of only saying it verbally (4)
- Maintain an orderly speaking sequence to avoid overlapping conversations
- Book sign language interpreters (3)

Gabriel's Strategies

Gabriel's strategies to manage his visual impairment.

What Gabriel does:

1. Enlarges visual content on a tablet
2. Increases the contrast of visual content on a tablet
3. Uses a large screen
4. Works in a well-lit workspace
5. Uses a screen reader to listen to textual content
6. Moves his head to compensate for a small field of vision

What Gabriel's teachers can do:

- Provide lecture materials early (1, 2)
- Structure lecture materials consistently (6)
- Avoid embedding text in graphics
- Use digital documents instead of scanned ones (5)
- Provide alternative text for images (5)
- Verbally describe visual content during lectures
- Ensure good lighting conditions in their background during video conferences
- Address visually impaired students by name
- Allow extra time for written assignments

Maxi's Strategies

Maxi's strategies to manage their mental illness.

What Maxi does:

1. Spends time in nature and cultivates hobbies
2. Takes regular breaks to manage concentration problems
3. Adapts to a slower learning speed
4. Avoids multitasking and distractions
5. Studies remotely
6. Creates daily plans, using structures to enforce productivity
7. Waits for "good days"
8. Utilizes alternative examination formats
9. Attends therapy and applies skills learned there
10. Takes medication

What Maxi's teachers can do:

- Provide lecture content early (3, 4, 7)
- Schedule the upload of lecture content at fixed times (6, 9)
- Provide digital streaming of lectures (5)
- Offer asynchronous access to lectures (2, 3, 7)
- Assist with group organization
- Hold breaks (1, 2)
- Offer various ways of getting in contact
- Refer students to counseling
- Create a trusting atmosphere and
- Offer individual arrangements with students (2, 3, 5, 7, 8)
- Give trigger warnings for sensitive content

Michelle's Strategies

Michelle's strategies to manage her chronic illness.

What Michelle does:

1. Takes regular breaks to manage exhaustion and for restroom visits
2. Prioritizes activities to budget her energy

3. Plans ahead to know the location of restrooms
4. Reduces stress to avoid relapses
5. Visits doctors and takes medication
6. Waits for "good days"
7. Gives and receives support in the support group
8. Educates the public via the support group

What Michelle's teachers can do:

- Plan lectures early (3, 4)
- Provide lecture content early (2, 3, 4, 5, 6)
- Provide digital streaming of lectures (2, 3, 4)
- Offer asynchronous access to lectures (1, 2, 4, 5, 6)
- Hold breaks (1, 3, 4)
- Refer to student counseling (7, 8)
- Create opportunities for exchange and information (7, 8)
- Create a trusting atmosphere and
- Offer individual agreements with students (1, 2, 3, 4, 5, 6)

Kilian's Strategies

Kilian's strategies to manage his motor impairment.

What Kilian does:

1. Uses a wheelchair and orthoses
2. Utilizes a large field keyboard and a trackball
3. Takes medication and undergoes physiotherapy
4. Listens to content instead of reading due to eye muscle fatigue
5. Takes regular breaks as constant muscle tension is tiring
6. Reduces stress to avoid increased spasticity

What Kilian's teachers can do:

- Offer asynchronous access to lectures (5)
- Provide materials in multiple formats (4)
- Allow sufficient time for room changes between lectures
- Hold breaks (5)

- Refer to student counseling
- Create a trusting atmosphere and
- Offer individual arrangements with students (3, 4, 5, 6)
- Communicate directly with the student, not their assistant

Aleksandr's Strategies

Aleksandr's strategies to manage his autism.

What Aleksandr does:

1. Follows routines and structures to avoid forgetting tasks due to hyperfocus
2. Minimizes stimuli, e.g. by using headphones, to avoid overstimulation
3. Uses self-stimulation strategies, e.g. fidget toys, to avoid understimulation
4. Masks, e.g. holds eye contact, to appear neurotypical
5. Lives at home to get help with daily organization

What Aleksandr's teachers can do:

- Write clear assignments without room for interpretation
- Provide lecture content both orally and in writing
- Design low-stimulus environments (2)
- Avoid spontaneous changes (1)
- Refer to student counseling
- Create a trusting atmosphere and
- offer individual arrangements with students (1, 2, 3)

7.1 Hannah's Game

In the game about Hannah, the strategy of using subtitles is chosen as the core game mechanic. The potential improvement through teaching staff's actions is to correct automatic subtitles. Given Hannah's field of study, which is mathematics, mathematical problems are selected as the primary tasks.

Following the BlindDate pattern as explained in chapter 5.4, the game's concept is that the mathematical problems are initially presented to the player solely through auditory means (Task 1). Once the simulation of Hannah's hearing impairment begins, the lecturer's voice is replaced with static noise (Task 2). Hannah recommends that the player use automatically

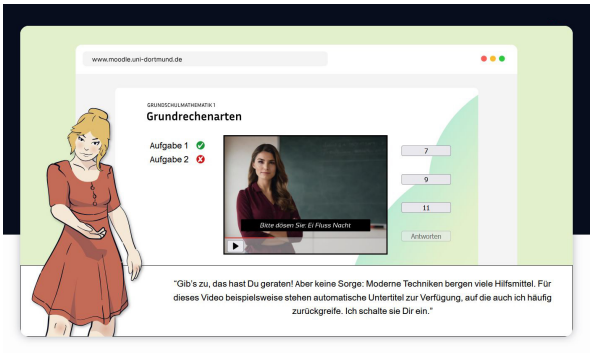


Figure 13: Hannah's Game

generated subtitles as a strategy, which, however, are highly inaccurate (Tasks 3, 4, 5). It is only after a manual correction by the lecturer that the subtitles accurately reflect the math problems (Tasks 6, 7, 8).

The game's user interface is reduced to keep the focus on the important elements. Within a fictitious browser window and integrated into the university's Moodle course, the lecture video is displayed. While the alleged video with subtitles is actually just a static image, the button to play the video is interactive for the player and plays the auditory mathematical problems. To the right of the lecture video, three solution options for each problem are available as buttons. To the left of the lecture video, there is an overview showing which problems have been answered correctly or incorrectly. Hannah appears in the left part of the user interface, facing the viewer and positioned in front of the entire game scene. Her words are displayed below the playable area.

The texts of the game, translated from German into English, are as follows:

Task 1: "Hannah watches the recording of the last lecture, which she missed due to a cold. She would like to solve the tasks set by the lecturer to improve her understanding of the content. Can you help Hannah?"

Task 2: "Hannah cannot hear the sound properly due to her hearing impairment. Without the soundtrack of the video, however, it is impossible to follow what the lecturer is saying."

Task 3: Hannah speaking: "Admit it, you just guessed that! But don't worry: Modern technology offers many helpful tools. For example, there are automatic subtitles available for this video, which I also use frequently, because they are very common nowadays. I'll switch

them on for you."

Task 4: Hannah speaking: "That's a bit better, isn't it? Unfortunately, automatic subtitles are often not very good, as the speech recognition software doesn't understand many words correctly and therefore displays them incorrectly."

Task 5: Hannah speaking: "It would save me a lot of guessing if the lecturer corrected the subtitles manually before she puts her videos online. I'll write her an email straight away and ask her to do it."

Task 6: Hannah speaking: "The lecturer responded to my request and corrected the subtitles of the remaining tasks manually with a program! You'll soon realize that you can work much better if you don't have to play a quiz game at the same time."

Task 7: Hannah speaking: "Most of the time I manage well at university, because I wear hearing aids on both sides and have my strategies. But with a little support, I can manage my lectures even more efficiently."

Task 8: Hannah speaking: "By the way: Limited hearing doesn't really mean that I only hear static noise. I have to concentrate very hard to make sense of small fragments of sentences. But the strategies I've just shown you are the same!"

End: Hannah speaking: "Thank you for your help! Students with disabilities have different strategies that help them in various situations. However, if lecturers generally pay attention to accessibility when designing their lectures, some time-consuming strategies aren't even necessary."

The early prototype of the game was implemented in Figma. In this prototype, only one of the three answer options for each math question was clickable. This design allowed users to sequentially see what would happen if they chose a correct or incorrect answer. There was no audio output. Instead, the first task, which was intended to be auditory, was presented in text form. For subsequent tasks, the intended auditory noise was simulated by jumbled text. The exact appearance and arrangement of the user interface elements were further refined. The texts were already finalized at this stage and only slightly adjusted during the subsequent programmatic implementation.

The final implementation was done in the JavaScript programming language with the Svelte library for easy embedding into the BlindDate platform. For details, see chapter 7.4).

7.2 Gabriel's Game

In the game about Gabriel, the strategy of moving his head to compensate for a small field of vision is chosen as the core game mechanic. The potential improvement through teaching staff's actions is to structure lecture materials consistently. Given Gabriel's field of study, which is social work, the task is to find some information on slides with the declarations on human rights.

Figure 14: Gabriel's Game

Following the BlindDate pattern as explained in chapter 5.4, the game's concept is that the slides are initially presented to the player as a whole (Task 1). Once the simulation of Gabriel's visual impairment begins, they can only be seen through a small circled area in an otherwise black screen (Task 2). Gabriel recommends that the player move their head, i.e. the computer mouse, to view the slides bit by bit (Tasks 3, 4, 5). However, the information needed is always placed in different, random positions on the slides. It is only after a restructuring of the slides by the lecturer that the information can be found quickly (Tasks 6, 7, 8).

The game's user interface is designed to be straightforward. Within a fictitious browser window, integrated into the university's Moodle course, the lecture slides are displayed. To the right of the slides lies Gabriel's notebook, where he notes down the sources. The user input occurs here through text fields. Additionally, this notebook provides an overview of correctly or incorrectly solved tasks. Gabriel appears on the left part of the user interface, facing the viewer and positioned in front of the entire game scene. His words are displayed below the playable area.

The texts of the game, translated from German into English, are as follows:

Task 1: "Gabriel wants to take note of the pages in the textbook where he can find further information on the content of the slides. The professor has skilfully integrated these references into the slides as small, red info boxes. Can you help Gabriel?"

Task 2: "The task is not that easy when your field of vision is restricted. This is the case for Gabriel due to his glaucoma. This means that it is not possible for him to have a complete overview of what is in front of him."

Task 3: Gabriel speaking: "Don't worry: Over time, you develop strategies to cope with a visual impairment. It helps me to move my head back and forth a lot to find my way around a document. It may seem strange to outsiders at first, but it works. Give it a try!"

Task 4: Gabriel speaking: "How's it going? Admittedly: I need more time than a person without a visual impairment to grasp all the content in a document bit by bit using this method. What's more, constantly moving my head puts a strain on my neck in the long run."

Task 5: Gabriel speaking: "It would be easier for me to oversee the sources if the info box was always in the same place on a slide. I'll email my lecturer straight away and ask if he can change that."

Task 6: Gabriel speaking: "The lecturer has adjusted the slides! In his email, he says that the source is now always placed to the right of the title. You'll soon realize how much faster you can make progress with the tasks from now on."

Task 7: Gabriel speaking: "I generally manage well during my studies, as I've got used to the restricted view over the years. But with a little support, I can learn even more efficiently in the lectures."

Task 8: Gabriel speaking: "By the way, my field of vision isn't really black on the periphery. My brain adds what it expects to see to the areas that my eyes don't cover, and puts them together to form an image. That's why I often overlook things. But the basic problem and the strategies are the same!"

End: Gabriel speaking: "Thank you for your help! Students with disabilities have different strategies that help them in various situations. However, if some aspects are already taken

into account by the teachers, time-consuming strategies are often no longer necessary!"

The early prototype of the game was implemented in Figma. In this prototype, the hole representing Gabriel's field of vision could not be moved freely. Instead, it jumped to predefined positions with each click, providing the player with a sense of how they might view different sections of the slides. Similarly, the player could not enter the solution numbers freely. Instead, pre-defined numbers appeared when clicking on the input field, illustrating the consequences of entering correct or incorrect answers. At this stage, the texts were finalized and only minimally adjusted during the subsequent programmatic implementation. The exact appearance and arrangement of the user interface elements were also revised.

The final implementation was done in the JavaScript programming language with the Svelte library for easy embedding into the BlindDate platform. For details, see chapter 7.4.

7.3 Maxi's Game

The game focused on Maxi and the application of the guidelines to this case required a more extensive game design process, which will be examined in detail below.

The uniqueness of this game lays in the nature of the impairment. A psychological impairment is more challenging to simulate because it involves internal, often invisible, experiences that are difficult to replicate through typical game mechanics such as visual or auditory alterations.

7.3.1 Impairment

Even when the impairment of the respective persona is not the focus of the game, it still needs to be represented first so that it can be partially overcome with a strategy. In Maxi's case, this involves depicting depression and anxiety disorders, which need to be either realistically or abstractly experienced. The idea was to portray a concrete panic attack. The panic attack could be represented visually through blurred vision and auditorily through sounds like a racing heartbeat, rapid breathing, or distorted noise. The tasks given by the lecturer could be presented to the player as text or audio. In the former case, they could be distorted by jumbled letters, and in the latter, by warped audio. All aforementioned symptoms could intensify based on decreasing energy or rising panic, indicating that there could be multiple levels of panic. On one hand, this would mean that the visual and auditory effects would become more pronounced for the player. On the other hand, the display of energy or panic could be visualized as a bar that fills up or empties, reflecting the increasing severity of the symptoms.

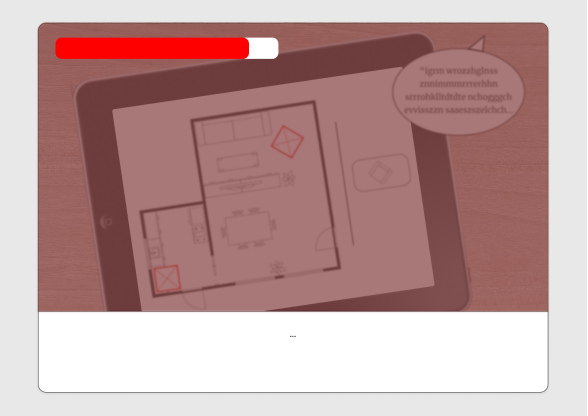


Figure 15: Maxi's symptoms during a panic attack

In transitioning from task 1, where the player can easily complete the task, to task 2, where the player is unable to complete the task, the initial idea was to display almost full panic on the panic bar during task 1. This would justify the onset of a panic attack in task 2. However, if the symptoms of overload increase progressively as the panic bar fills, these symptoms would need to be visible even during task 1. This presents a challenge, as task 1 should ideally be free of impairment according to the established pattern. The idea originates from the observation that Maxi generally copes reasonably well until the impairment fully manifests in the form of a panic attack. This contrasts with Gabriel and Hannah, where the impairment is constant. Nonetheless, neither Hannah nor Gabriel explain to the player why the impairment was not present before task 2. Hence, deviating from this pattern for Maxi to provide additional justification may not be necessary.

7.3.2 Strategy

The strategy selected from all the mentioned options is that Maxi takes regular breaks to calm down. It was chosen for its practical relevance and realism.

Real-Time The initial concept for enforcing breaks involved a "real-time" approach. The idea was that if the player refrained from moving the mouse for a few seconds, the panic attack would gradually subside. Conversely, resuming mouse movements while solving the tasks would slowly increase the panic level again. This mechanism would need careful balancing to function effectively. The approach would be particularly effective if the task required continuous mouse movement to maximize the impact. An example of such a task could be a "Whack-A-Mole" game, adapted with an architectural theme.

While this is generally implementable, it represents a different type of tasks and intensity of play while completing tasks compared to those in Gabriel's and Hannah's scenarios. The pattern of having eight tasks, including one that is easily solvable, one that is unsolvable, and so on, cannot be effectively maintained. Players would need to be incentivized to engage with the task and thus move the mouse, which would shift the tasks from being easy and mindless to predominantly skill-based, rather than challenging primarily due to the simulated impairment.

Under the same condition but with a slower-paced task, the player could use the time while holding the mouse still, and thus seeing the screen clear up, to think about the solution to the task. Therefore, unlike what Maxi would require, the player would not take a genuine break.

Turn-Based The second approach to enforcing breaks is therefore "turn-based". The idea is that the player presses an explicit "Pause" button, effectively closing their virtual eyes and ears, thereby becoming unable to perceive or think about the task. To ensure that the player is compelled to press the pause button rather than continuing with impaired visibility under overload conditions, one possibility could be that clicking input becomes disabled once the overload reaches a certain threshold. In this context, one challenge would be to conclude the second task, where no option to take a break is present yet. A possible solution could be to implement a fixed time duration after which the task automatically concludes.

In this context, the overload could also be implemented gradually rather than in real-time. This would mean that the panic status would be tied to the number of interactions or tasks completed. This is preferable to the alternative approach where the overload continuously increases while the player is idle, as the player might not have the time or might feel too stressed to read the texts. However, this mechanism would also need careful balancing. The complete filling of the panic bar should not extend across multiple tasks, as the strategy is intended to be applied within the context of each individual task.

Break Game To ensure that the player genuinely takes a break, an additional idea was proposed. During the break, the player must engage in a specific activity rather than simply waiting. This concept draws from real-life mindfulness exercises and techniques used to manage panic attacks, such as breathing exercises or enumerating objects that can be seen, heard, and felt. For example, this could be implemented as a minigame where the player follows a shape with the mouse pointer. This approach ensures that the player is distracted from the main task. Completing this activity effectively could result in a faster recovery of the panic bar, reinforcing the benefit of taking a meaningful break.

7.3.3 Accommodation

The chosen accommodation for Maxi involves allowing them to attend lectures remotely rather than in person. This accommodation demands more effort from educators compared to making slight adjustments to presentation slides as required for Gabriel, or similar examples. However, it is also acceptable as a learning outcome for teaching staff to simply understand and accept why someone might not be able to or want to attend in-person lectures.

Synchronous Online Lecture The first idea involves having Maxi attend lectures from the safety of their own home, where they experience fewer or less severe panic attacks. This could be implemented in the game mechanics by the panic bar filling more slowly, or the required breaks being shorter during the three tasks that take place at Maxi's home. This idea would again need careful balancing to ensure that the difference between attending in person and from home is noticeable.

Asynchronous Online Lecture The second idea involves Maxi attending lectures from home, with the lecture being asynchronous videos instead of live. Maxi can pause the entire lecture video while taking a break, ensuring that they do not miss anything during the break. The key difference from an in-person lecture is that Maxi does not miss any content while calming down. During an in-person lecture, for instance, the slides might continue to change and the player could thus miss tasks they were supposed to solve, because they could not hear the lecturer.

This raises the question of how the missing of tasks should be handled for tasks two to five, which take place during the in-person lecture. The general issue at hand is that the break, i.e. the strategy that is supposed to enable the player to solve the task, does not feel like a positive aspect but rather a necessary evil. Unlike the games about Gabriel and Hannah, where strategies noticeably help the player, here, it does not. Although the break ultimately lowers the panic bar and thus allows the player to continue afterward, during the break itself, it has the same negative effect as the panic attack, in that the player cannot actively work on the task and even misses something.

Perhaps it is acceptable for the breaks in this game to have a negative connotation. This effectively demonstrates Maxi's struggles, as Maxi likely does not find it enjoyable to miss out on things due to their necessary strategies. This strategy is indeed challenging to apply in the context of an in-person lecture, and this realism is important. For each task, a portion that is not missed can still be correctly completed, so the entire task is not failed. This might be sufficient to convey to the player that the strategy helps them manage their tasks better.

7.3.4 Task

Maxi's tasks should be related to their field of study, which is architecture. The tasks should be inherently simple and solvable with just a few clicks, as the player should have no difficulty completing them without the simulated impairment. At the same time, the impairment should naturally make the tasks more challenging to solve.

The first idea was to have the player complete an image of an architectural structure by adding a puzzle piece, suggesting that Maxi is in the process of completing a blueprint or similar document. While it fulfilled the requirement to be an easy task for the player, this concept felt too abstract and failed to clearly represent what Maxi is actually doing. If the blueprint is on paper on a table, Maxi would need to draw the missing part on their own rather than having a choice of pieces to place. Even with a revised graphic, where the document appears as if Maxi has indeed been drawing it, the problem of the abstraction of the action remains.

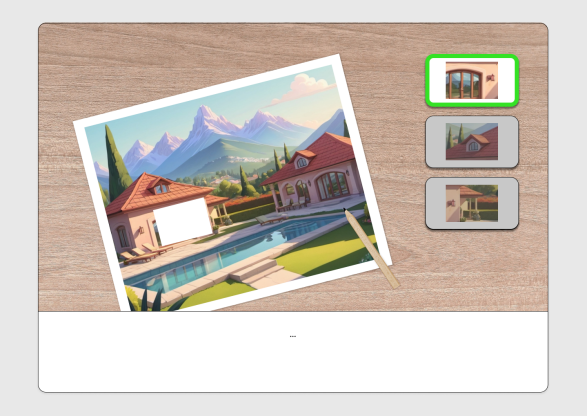


Figure 16: Idea 1-1 for Maxi's task

A second idea attempted to solve this problem by removing the abstract space with buttons that does not exist for Maxi. This would be more immersive as the player interacts with the very part of the drawing where Maxi is also interacting. In this idea, the player would define the "where" instead of the "what", determining where Maxi should draw something rather than which piece of furniture. Depending on what the lecturer says, the player would help Maxi identify where the mentioned element should go, and Maxi would then carry out the actual drawing.

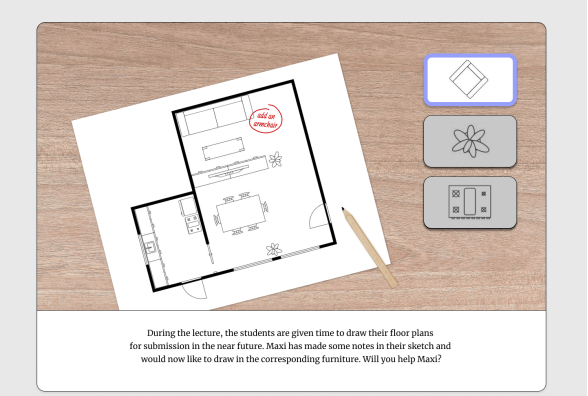


Figure 17: Idea 1-2 for Maxi's task

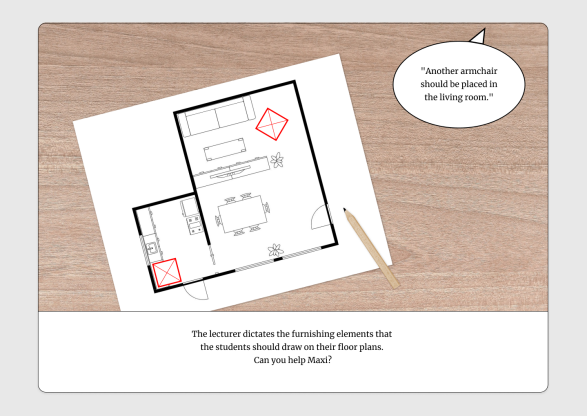


Figure 18: Idea 2 for Maxi's task

A third approach could legitimize the presence of buttons and selectable assets rather than removing them by design. In this case, Maxi would not be working on paper but using digital CAD software, which indeed has templates for furniture pieces that can be placed. The immersion remains intact, as the buttons exist for both the player and Maxi, with both working directly on a tablet in front of Maxi.

The idea to incorporate a tablet would work with both previous task concepts, "what to place" and "where to place". However, it does not offer a significant advantage for the second approach since the legitimacy of buttons was not an issue in that context. One concern with this approach is that recognizing the furniture pieces may not be sufficiently easy. However, a moment of reflection seems acceptable, as the game involving Hannah also requires solving brief math problems.

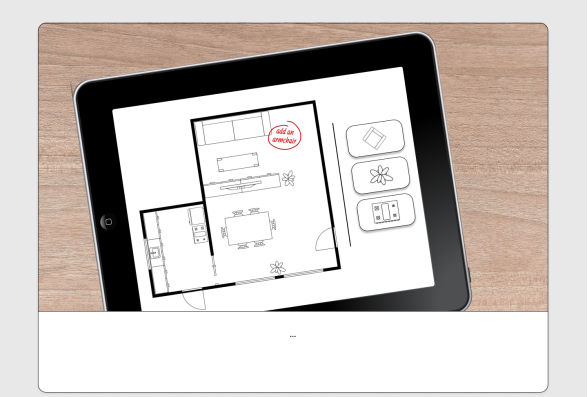


Figure 19: Idea 3 for Maxi's task

7.3.5 Other Thoughts

An energy bar could also be utilized for other personas. Both Michelle and Kilian mention energy management in their strategies. Similarly, an overload situation could also be utilized for Sasha. While it would be ideal to vary the mechanics to ensure that the games on the BlindDate platform do not become too similar, no further games will be developed in the course of this work. Therefore, an overload situation as well as an energy or panic bar can be used for Maxi.

The challenge in finding a playable strategy and accommodation for Maxi, compared to Gabriel and Hannah, reflects a realistic scenario. It is indeed more difficult for actual teaching staff to identify and implement effective strategies for Maxi than simply applying assistive technology for other students.

7.3.6 Final Product

In the final game about Maxi, the strategy of taking breaks to calm down in a panic attack is implemented as the core game mechanic. The potential accommodation by teaching staff is to provide asynchronous online lectures, which allow Maxi to not miss any content while taking breaks. Given Maxi's field of study, which is Architecture, the task is to place two pieces of furniture per task onto a blueprint in a CAD software.

Following the BlindDate Pattern as explained in chapter 5.4, the game's concept is that the first task can be understood and completed successfully (Task 1). Once the simulation begins, Maxi's panic attack sets in, distorting their vision and hearing (Task 2). Maxi recommends that the player take a break to calm down (Task 3, 4, 5). This is implemented in a way that guides the player through a breathing exercise alongside Maxi. While the break enables

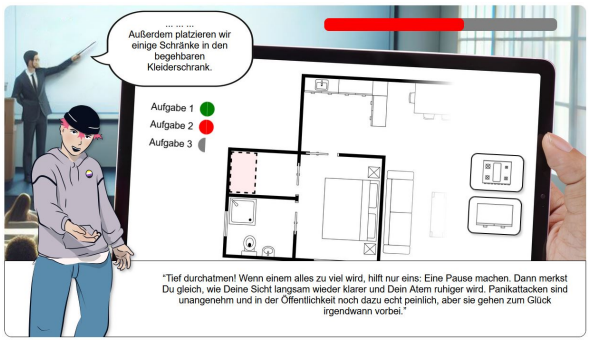


Figure 20: Maxi's Game

the player to finish the second part of each task, they miss the first part due to having their virtual eyes closed during the continuing lecture. When the lecturer finally offers the content as asynchronous videos, Maxi can stop those while taking a break and thus does not miss any more information (Task 6, 7, 8).

The game's user interface initially shows a lecture hall from Maxi's point of view. They hold a tablet with the CAD software in their hand, which is where all user input is done by drag and drop mechanics. Additionally, this tablet provides an overview of correctly or incorrectly solved tasks. Behind the tablet, the lecturer can be seen. He introduces the respective tasks, which are represented by speech bubbles with written instructions. When the setting shifts to online learning, Maxi's desk with a screen displaying the lecture can be seen in the background. Maxi appears on the left part of the user interface, facing the viewer and positioned in front of the entire game scene. Their words are displayed below the playable area. Initially, the idea was to make the fact that Maxi had missed content more explicit in the user interface. For instance, a set of slides from the lecturer could suddenly appear several pages ahead, or the lecturer could display a floor plan that fills in more completely than Maxi's. However, this approach proved unfeasible due to space constraints. Either it would have been difficult to discern what was being shown by the lecturer, or the tablet, which serves as the player's interactive workspace, would have become too small, leading to a suboptimal user experience.

The texts of the game, translated from German into English, are as follows:

Task 1: "In today's lecture, the architecture students practice using CAD to create floor plans. To do this, they create a floor plan according to the lecturer's instructions. Maxi is also doing their best to fulfill all the requirements. Can you help Maxi?"

Task 2: "Maxi's mental illness often manifests itself in the form of panic attacks. When everything blurs before their eyes and they can only hear the lecturer indistinctly, solving seemingly simple tasks suddenly becomes very difficult for Maxi."

Task 3: Maxi speaking: "Take a deep breath! When everything becomes too much, there's only one thing to do: Take a break. Then you will immediately notice how your vision slowly becomes clearer and your breathing calmer. Panic attacks are unpleasant and also really embarrassing, but fortunately, they always pass eventually."

Task 4: Maxi speaking: "Are you alright? Unfortunately, taking a break from an in-person lecture means that I sometimes miss out on things. But there's no point in continuing to work in a moment like that, because then I tend to make a lot of mistakes. And once I'm really stuck in fear, I can't do anything anyway."

Task 5: Maxi speaking: "Even if I do everything right, the fear of not being as good as my fellow students keeps boiling up inside me. It would be more pleasant for me not to have to sit in a packed lecture hall with everyone else. I'll ask the lecturer if he can broadcast the lecture online."

Task 6: Maxi speaking: "The lecturer has agreed to upload his lecture as a video in the future! Even when I'm at home, I'm not always safe from my panic attacks. But with the asynchronous videos, I can choose my own learning pace and no longer miss anything if I have to take a break in between."

Task 7: Maxi speaking: "I can manage my studies all right. After all, I've already made it to the Master's degree! But when lecturers show a bit of understanding of my situation, it takes a lot of stress off me. Then I also learn more than when I just power through."

Task 8: Maxi speaking: "Of course, there are many different mental illnesses with many different symptoms. Even depression, for example, doesn't manifest itself in the same way for everyone. But everyone benefits from being able to organize their studies and learning flexibly - even students without mental health problems!"

End Maxi speaking: "Thank you very much for your help! Lecturers are no therapists and they're not supposed to be, either. I don't need them to give me advice on how to deal with my mental illness. But they shouldn't forget to take invisible impairments like mine into

account when planning their lectures."

The early prototype of the game was implemented in Figma. While a simple drag-and-drop mechanic was already simulated, the furniture could not be placed on the blueprint arbitrarily. Instead, the player was subsequently shown what would happen if they chose a correct or incorrect position. The mini-game intended to be played during the pause was only realized as a rough concept and later underwent a redesign. While an initial audio output was available, the specific audio files were later refined. At this stage, the texts were already finalized. The exact appearance and arrangement of the UI elements were slightly revised.

The final implementation was done in the JavaScript programming language with the Svelte library for easy embedding into the BlindDate platform. For details, see chapter 7.4.

7.4 Programmatic Implementation

The games are all fundamentally built on the same principle and differ programmatically only in the implementation of the depicted strategies. Based on this foundation, new games can be created relatively quickly.

Each game contains a "contentsArray" that stores all data that varies from task to task. This includes the background image with the fictional slides, the text displayed below the game, whether the persona is shown and, if so, with what mood, as well as the specific task and its solution.

The items included in the contentsArray may look slightly different depending on the data of each persona:

Hannah:

```
    {
   image: 'Tasks/hannah-hg-task-3.svg',
   audio: '/Audio/static.mp3',
   mood: 'Persona/hannah-explaining.svg',
   description:
    '"Gib's zu, das hast Du geraten! Aber keine Sorge: Moderne Techniken
    bergen viele Hilfsmittel. Für dieses Video beispielsweise stehen
    automatische Untertitel zur Verfügung, auf die auch ich häufig
    zurückgreife. Ich schalte sie Dir ein."',
   btnA: { answer: 7, correct: false },
   btnB: { answer: 9, correct: true },
   btnC: { answer: 11, correct: false }
  }
```

Gabriel:

```
    {
   image: 'Tasks/gabriel-hg-task-3.svg',
   mood: 'Persona/gabriel-explaining.svg',
   description:
    '"Mit einem eingeschränkten Gesichtsfeld ist die Aufgabe gar nicht
    so leicht, was? Mir hilft es, den Kopf viel hin und her zu bewegen,
    um mich in einem Dokument zurechtzufinden. Das mag für Außenstehende
    zunächst  ungewöhnlich wirken, aber es funktioniert. Versuch‘s mal!"',
   solution: '19'
  },
```

Maxi:

```
{
    image: 'Tasks/maxi-hg-task-3.jpg',
    mood: 'Persona/maxi-explaining.svg',
    description:
        '"Tief durchatmen! Wenn einem alles zu viel wird, hilft nur eins:
        Eine Pause machen. Dann merkst Du gleich, wie Deine Sicht langsam
        wieder klarer und Dein Atem ruhiger wird. Panikattacken sind unangenehm
        und in der Öffentlichkeit noch dazu echt peinlich, aber sie gehen zum
```

```
        Glück irgendwann vorbei."',
    setting: 'live',
    dropzones: [
        {
            id: 'dropzone1',
            left: '37.5%',
            top: '60.4%',
            width: '7vw',
            height: '4.5vw',
            rotation: '-87deg',
            solution: 'draggable2'
        }
    ],
    draggables: [
        { id: 'draggable1', name: 'herd', img: './Draggables/drag-herd.png' },
        { id: 'draggable2', name: 'schrank', img: './Draggables/drag-schrank.png' }
    ],
    task:'Außerdem platzieren wir einige Schränke in den
        begehbaren Kleiderschrank.',
    panic: 90
}
```

A variable "taskIndex" increments upon completing a task and thus always stores which task is currently active. This way, the necessary data for each task is loaded accordingly.

```
let taskIndex = 0;
taskIndex++;
descriptionText = contentsArray[taskIndex].description;
if (taskIndex == 3) {
    personaHidden = false;
}
```

The layout for all games is structured as follows:

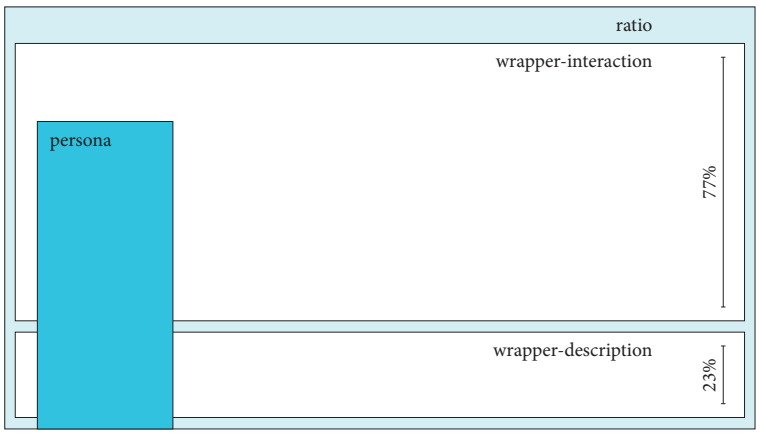


Figure 21: The Game Layout

```
<div class="ratio">
    <img class="persona" src={personaImage}/>
    <div class="wrapper-interaction">
    <img class="background-interaction" src={interactionBackground} />
    <further user interface elements>
</div>
<div class="wrapper-description">
    <p class="description" >{descriptionText}</p>
</div>
```

The class ”ratio” encompasses the entire game and maintains a 16:9 aspect ratio. Even when the BlindDate page with the embedded game is displayed in a non-fullscreen browser window, the game is always scaled to fit the available space while maintaining the 16:9 ratio. Only if the window becomes too small for effective gameplay due to reduced text and image sizes, a warning is displayed, advising the player to use a larger window or device.

```
.ratio {
    position: relative;
    padding-bottom: calc(100vw * 9 / 16);
}
```

Within the ”ratio” class, there are three main classes: ”persona”, ”wrapper-interaction”,

and "wrapper-description". The "persona" class contains the persona image, which is displayed with an elevated z-index in front of the entire user interface when the persona is present.

```
.persona {
    position: absolute;
    transform: translate(-20%, 10%);
    z-index: 3;
}
```

The "wrapper-description" class represents the lower white area, which contains the text and no interactive elements. It occupies 23% of the total height. The "wrapper-interaction" class corresponds to the upper part, occupying 77% of the height. This is where the gameplay activities occur. This container has the virtual Moodle courses as the background image and contains all clickable, fillable, and other interactive elements. For example, in Gabriel's game, this includes the notepad with input fields, in Hannah's game, it includes the play button for the lecture video and the three answer buttons, and in Maxi's game, it includes the movable furniture pieces.

```
.wrapper-description {
    position: absolute;
    width: 100%;
    height: 23%;
}
.wrapper-interaction {
    position: absolute;
    width: 100%;
    height: 77%; /* + description = 100%*/
}
```

Contrary to the principles of BlindDate, these games were deliberately not created to be accessible in accordance with WCAG. This decision stems from the specific game mechanics designed to simulate various disabilities. For example, a game that simulates visual impairments cannot be played with a screen reader, and one that simulates hearing impairments cannot be played with subtitles. Implementing such accessibility features would undermine the intended experience, as they would counteract the very challenges the games are meant to convey.

7.5 Further Ideas

The following tables presents several ideas for additional simulation games tailored to other personas. While some ideas are already well-developed, others are still in early stages and would require further conceptual work.

7.5.1 Kilian (Mobility Impairment)

Task	Impairment	Strategy	Accommodation
	The computer mouse can no longer be used to solve the tasks due to Kilian's severe spasticity.	Only the keyboard is used to solve the tasks. This can be cumbersome at times, as the tab order of the content is often incorrect.	
	Kilian's hands tremble due to a tremor, causing each touch input to be registered multiple times when attempting touch interactions.	The touch sensitivity of Kilian's tablet is reduced.	

For Kilian, two concepts were generated. Regarding the first concept, there are no concrete ideas for possible tasks yet. Kilian is studying English, so the tasks should be relevant to this field. Additionally, the tasks should generally be solvable exclusively with mouse clicks, to highlight the contrast with the use of the strategy. The tab order should be important, as otherwise, the accommodation would not be necessary.

Regarding the second concept, there are no concrete ideas for possible tasks yet. To align with the strategy, the tasks should inherently require (fictive) touch input. Additionally, there are no specific ideas for accommodations by lecturers. One possibility might involve teaching them to apply sufficient spacing between buttons in interface design. However, this approach is more relevant for web designers than for educators, as the latter typically do not engage in such design work in their daily tasks.

7.5.2 Faiza (Care Responsibility)

Task	Impairment	Strategy	Accommodation
	Due to her son being sick, Faiza is unable to attend the lecture and misses all the content.	Faiza reviews the lecture online while her son is asleep, but the conditions are not ideal. The room is dark and quiet, and Faiza only has access to a smartphone.	The learning materials are provided in various modalities. For example, there is a text version available to avoid playing videos in a quiet environment, and an audio file to avoid reading on a small screen.

For Faiza, one idea has been generated. Given that Faiza studies computer science, the tasks should be relevant to this field. The accommodation needs further definition, as it includes conflicting ideas as of now. If the accommodation is a transcript, the game might end up being quite similar to the one about Hannah.

7.5.3 Michelle (Chronic Illness)

Task	Impairment	Strategy	Accommodation
	Michelle is anxious about embarrassing herself in front of others, which makes her hesitant and self-conscious.	Michelle chooses a seat at the edge of the lecture hall to be able to quickly access the restroom if needed.	
	Michelle is perceived poorly by her fellow students and lecturers, who consider her lazy due to her frequently leaving the lectures.	Michelle educates the lecturer and her fellow students about invisible disabilities.	The lecturer provides time and space in their course for this educational work.

Two ideas were generated for Michelle. Since Michelle studies music, the tasks should be related to this field. Regarding the first idea, there is uncertainty about how players are expected to apply this strategy and how it simplifies the tasks. It could be implemented as a reduction of the fear of embarrassment, similar to the panic bar in the game about Maxi. However, it is necessary to question whether this strategy would genuinely address Michelle's anxieties and her negative self-image.

Regarding the second idea, it is still unclear how the accommodation might function. One possibility is that Michelle's fellow students may perceive her more favorably if they realize that the lecturer supports her. However, it is not clear how the task would be made easier through this approach.

8 Evaluation

8.1 Pre-Study

A pre-study was conducted during a university-wide symposium at the author's institution. This symposium brought together interested faculty members to discuss best teaching practices. At the start of the symposium, a brief presentation on the BlindDate platform was

given as part of a keynote speech. Following this, attendees had the opportunity to visit the BlindDate project booth to explore the platform and try out the game about Maxi, which was still under development.

This pre-study was conducted exclusively for the game about Maxi. Due to the limited capacity at the symposium, only one game could be tested, and the most complex game was chosen for this purpose. The pre-study aimed to identify any issues related to understanding or operation that could impact the actual evaluation of the game's effectiveness. Since the attending faculty members were the target audience for the BlindDate platform, this also formed a part of a user-centered design process.

The interactions with interested attendees at the booth were informal conversations without quantitative measures. Conducting an official evaluation with consent forms would have been too extensive for the context given. Participants navigated the prototype, asked questions to clarify their understanding, and provided feedback. Five interested individuals reviewed the prototype. Of these, three were known to the author, while two were unfamiliar.

Feedback

The feedback on the prototype was overall positive. One participant summarized their personal learning by saying, "I now understand that, as a teacher, my teaching methods can sometimes prevent an otherwise effective strategy from being applied successfully". Another participant described the game as "impressive". The presence of and assistance provided by the persona were particularly highlighted as a positive aspect, as it successfully prompted a shift in perspective for the participant mentioning this.

Some participants offered ideas that were not feasible to implement. For instance, one participant suggested that the player should be able to complete more tasks without experiencing a panic attack before encountering it for the first time. However, this contradicted the existing pattern. Another participant suggested incorporating a selection of different support options for the fictional students. These options could either include a negative example, to illustrate what teaching staff should avoid doing, or all be correct, demonstrating that there are multiple equally valid ways to support students. However, this would require an entirely new game concept. Thus, these ideas were not pursued further.

Some participants' suggestions were contradictory. One participant proposed not displaying the informational texts while the player is actively completing a task, as it could divide their attention. They suggested showing the texts only during breaks. Another participant mentioned that the texts should not be displayed during breaks to ensure that these breaks are solely used for resting. The suggestion made by the second participant was accepted.

Some remarks from participants included valuable ideas that were implemented:

- One participant suggested that the panic state should be visualized in gray rather than red, as the color red is more commonly associated with anger.
- Another participant noted that in the first task that takes place during remote study, the player should not immediately experience a panic attack. They argued that this change would better emphasize the supportive aspect of being at home and also ensure that the player is more consciously aware of the scene transition. While this slightly deviates from the pattern, the idea was deemed useful and was implemented.

Only one participant expressed a noticeably negative attitude towards the game and the BlindDate platform in general. They clicked through the prototype without reading the texts, criticizing it as boring and repetitive. They also mentioned that they could not relate to the architecture theme, as they teach a completely different subject. Additionally, they found the tasks too simple and referred to their educational level as a university lecturer.

No improvements were derived from this encounter. Other participants disagreed with the negative feedback, stating that the simplicity of the tasks actually helped them focus more on the texts and the strategies being presented. The architecture theme was retained because it is intrinsic to the character of Maxi, who studies architecture.

Overall, it was most valuable to observe the participants during gameplay, independent of their verbal feedback. Several insights were gained from these observations:

- In this prototype, tasks during a panic attack were theoretically still solvable through logic, as the blurred effect allowed participants to recognize a significant portion of the floor plan. Some participants attempted to solve the tasks under these conditions and were confused when the prototype, due to its linear nature, forced them to provide an incorrect solution. In the subsequent version of the game, the representation of the overload was intensified to address this issue.
- At this point, the task overview did not yet differentiate between red (incorrect) and gray (incomplete) circles. From Maxi's perspective, this distinction is irrelevant, as a task not done is effectively a task done wrong. However, the idea arose that this distinction would better communicate the difference between having done something incorrectly and having been unable to complete it. Neither Maxi nor the player is incapable of completing the simple task. Instead, the panic, representing the impairment, makes it impossible at that moment. For the teaching staff, this learning outcome is more important than the strict realism of educational practice.

- In this prototype, the transition from one task to the next occurred automatically after completing a task. While the new task appeared on the tablet's task list, it was often overlooked due to the ongoing panic attack. Consequently, players frequently missed the new text that appears at the bottom, which poses a problem as these texts are essential for understanding the simulation. It was hoped that this issue would resolve itself once different tasks were represented by different floor plans, which were not yet implemented in the prototype. As a precaution, a "Next" button was also added, forcing players to actively complete the current task and proceed to the next one.

Contrary to expectations, the drag-and-drop mechanic did not pose any problems, and participants instinctively understood that they could lift the pieces of furniture with the mouse.

8.2 Study

As part of the SHUFFLE project, the personas, including two that feature a simulation game, have been evaluated. However, this evaluation was conducted without a specific focus on the simulation games themselves, and there was no explicit mention of the games among the qualitative responses.

The overall aim of this work's user study was to assess the impact of the games on the players and whether playing the games resulted in their desired effects. Consequently, the effectiveness of the guidelines on which the games are based is assessed. More specifically, this included the questions,

1. how participants rated the games' attractiveness,
2. whether participants gained theoretical knowledge
   on the topic of digital accessibility by playing the games,
   i.e. "Do they recognize accessibility needs more frequently?",
3. if participants showed more empathy towards
   people with disabilities after playing the games,
   i.e. "Are they more likely to respond to recognized accessibility needs?"

The developed guidelines and simulation patterns for BlindDate were not directly evaluated in this context, meaning that the games created using the guidelines were not compared to other types of games. Instead, the focus was on highlighting any potential positive effects of the games that were all designed according to the guidelines.

8.2.1 Demographics

The following demographic data were collected to provide context for the study:

- Age
- Gender
- Taught school type
- Taught subjects
- Prior knowledge of BlindDate:
  To determine the participants' familiarity with the platform and its concepts, which could affect their engagement with the study materials. This information was collected using a "yes or no"-question. If participants selected "yes", they were provided with an option to elaborate further in a text field.
- Prior knowledge of digital accessibility:
  To determine the participants' understanding of digital accessibility issues, which could affect their answers to quantitative and qualitative questions. This information was collected using a 5-item Likert scale. The labels for each item were as follows:
  - 'I know the subject very well'
  - 'I know the subject better than other teachers'
  - 'I have average knowledge of the subject'
  - 'I know little about the subject'
  - 'I don't know anything about the subject'

8.2.2 Attractiveness (1)

The games' attractiveness was measured with the User Experience Questionnaire (UEQ)[35]. The UEQ is an easy-to-use and fast "questionnaire to measure the User Experience of interactive products" (UEQ, 2024) that uses seven-stage semantic differentials. It was chosen because of its reliability and validity. While the original questionnaire contains six scales (Attractiveness, Perspicuity, Efficiency, Dependability, Stimulation, and Novelty) with 26 items, only the scales of Attractiveness (6 items), Stimulation (4 items), and Novelty (4 items) were used in this user study. The omission of entire scales is permitted by the UEQ handbook, unlike the omission of individual items. The remaining items were used in their original order and orientation, i.e. whether they start with the positive or negative term.

Attractiveness describes the "overall impression of the product" (UEQ, 2024) and whether

[35] https://www.ueq-online.org/

users like or dislike it. Stimulation and Novelty are hedonic qualities that further describe the users' non-goal-oriented impression of the product, with Stimulation answering the question "Is it exciting and motivating to use the product?" (UEQ, 2024) and Novelty "Is the product innovative and creative?" (UEQ, 2024). The pragmatic qualities of Efficiency, Perspicuity, and Dependability were not of interest in this user study.

Participants filled out the UEQ directly after playing each game, to catch their immediate impressions.

The results were compared between the different games as well as with the UEQ benchmark of 2024.

8.2.3 Knowledge (2)

One objective of the games was to provide players with theoretical knowledge and practical skills on the subject of digital accessibility. To assess this, the players were surveyed to see if they could remember the content covered in the games.

It was essential to neither overchallenge nor underchallenge participants with the knowledge questions. Questions that are too difficult and require a high degree of knowledge transfer could reveal gaps in the players' knowledge and make them feel insecure about further participating in the study. Questions that are too easy and of similar wording as the game content itself could give the players the feeling of being taken for a fool.

To generate the knowledge questions, it was determined which information could be derived from the games. This is detailed in the following lists. They further distinguish between information that can be exclusively obtained from the texts within the games and information that players experience firsthand through the game mechanics, the latter being highlighted with an asterisk (*).

Gabriel

Impairment:

- Glaucoma manifests itself in a restricted visual field.
- With a restricted visual field, it is difficult to overview things quickly *.
- A restricted visual field does not truly manifest as a black area with a hole.
- Instead, the brain attempts to reconstruct images that are not visible.

Strategy:

- One of Gabriel's strategies involves frequently moving his head from side to side to compensate for his limited visual field and to better perceive visual content *.

Disadvantages:

- Despite the strategy, Gabriel remains slower compared to students without visual impairments *.
- He often gets neck pain from the movement.
- Observers may perceive this movement as unusual, although it is normal and necessary for Gabriel.

Support:

- Lecturers can assist Gabriel by consistently designing their content, such as presentation slides, according to a uniform pattern *.
- This allows him to become familiar with the layout, reducing the need to visually search for information. Consequently, Gabriel can work more efficiently *.

Hannah

Impairment:

- A hearing impairment manifests itself in the fact that sound cannot be perceived correctly.
- Without sound, it is difficult to follow what is being said *.
- Hearing with a hearing impairment does not sound like a buzzing noise.
- People with a hearing impairment have to concentrate very hard to extract fragments of meaning from spoken content.

Strategy:

- One of Hannah's strategies involves activating subtitles for videos to compensate for her hearing impairment and to better understand the spoken content *.
- Automatic subtitles are widely available nowadays.

Disadvantages:

- Automatic subtitles often only match what is being said to a limited extent *.
- That is because speech recognition software does not understand words correctly.

Support:

- Lecturers can help Hannah by manually correcting AI-generated subtitles *.
- This reduces the need for her to guess the intended meaning in each instance, enabling

Hannah to work more efficiently *.

Maxi

Impairment:

- A panic attack can manifest as blurred vision and impaired hearing *.
- During a panic attack, the person may be unable to process information or respond appropriately. Consequently, any attempts to act are likely to result in mistakes *.
- Panic attacks are often unavoidable, even under optimal conditions.

Strategy:

- One of Maxi's strategies is to take breaks to calm down before continuing to work *.
- These breaks can, among other things, be utilized for grounding exercises.

Disadvantages:

- While taking a break, one may miss out on what is going on around them *.
- Panic attacks are physically unpleasant.
- Panic attacks in public are embarrassing.

Support:

- Lecturers can help Maxi by offering their lectures asynchronously, e.g. as videos *.
- This allows Maxi to control their own learning pace. By pausing the content while calming down, they ensure that no material is missed *.
- Maxi feels safer and more comfortable studying without other students around.
- lecturers are no therapists and are not required to offer guidance on managing mental health issues.
- However, lecturers should show an understanding of mental illness.

Ultimately, participants were presented with seven statements per game. They were asked to tick which information could be taken from the respective game, regardless of whether the statements were true. For each game,

- two of the statements included learning content that the participants could experience as game mechanics during play ("Playable").
- Two of the statements included learning content that could only be taken from the texts displayed in the game ("Readable").

- Two of the statements were true statements about the overarching theme of the game, but were not conveyed as content in the game ("Non-Content"), and
- one statement was a false statement on the topic ("Wrong").

This way, it was additionally possible to test the hypothesis that players remembered the content they played better than the content they read.
All statements presented to the players can be taken from the following tables.

Hannah (Hearing Impairment):

Statement	Type
'Automatically generated subtitles often only match what is said to a limited extent.'	Playable
'Teachers have the option of correcting automatically generated subtitles manually.'	Playable
'A buzzing noise is not a realistic representation of Hannah's hearing impairment.'	Readable
'Automatically generated subtitles are by now widely available.'	Readable
'In addition to subtitles, a clearly visible mouth image in lecture videos is also important for Hannah.'	Non-Content
'Speech recognition software often works better when people are speaking English.'	Non-Content
'A translation into sign language is generally a good alternative to subtitles.'	Wrong

Gabriel (Visual Impairment):

Statement	Type
'As he can't see everything, Gabriel has to search for individual elements on a slide first.'	Playable
'Despite his head movement strategy, Gabriel works more slowly than other students.'	Playable
'Constantly moving his head can cause Gabriel neck pain.'	Readable
'Gabriel's head movements can seem strange to outsiders.'	Readable
'As an alternative to head movements, Gabriel can use a screen reader.'	Non-Content
'In addition to the visual field impairment, Gabriel has difficulty recognizing contrasts due to glaucoma.'	Non-Content
'A standardized slide design makes additional alternative texts for pictures obsolete.'	Wrong

Maxi (Mental Illness):

Statement	Type
'During a panic attack, Maxi often no longer sees or hears their surroundings properly.'	Playable
'Lecture videos allow students to interrupt their learning if necessary.'	Playable
'Maxi's panic attacks sometimes just happen, even under the best conditions.'	Readable
'When Maxi has a panic attack in public, they are embarrassed.'	Readable
'The isolation that asynchronous teaching entails can also have negative effects.'	Non-Content
'At the beginning of a lecture video, a warning about sensitive content, so-called 'triggers', should be given.'	Non-Content
'Depression usually subsides after six to eight weeks.'	Wrong

8.2.4 Empathy (3)

In regards to empathy, the game has two primary objectives. The first objective is to demonstrate the adaptation and strategies employed by students with impairments, thereby helping participants understand that these students generally manage well in their daily lives and studies. This aims to enhance the participants' perception of students with disabilities. The second objective is to highlight potential support mechanisms that teaching staff can provide, thereby helping participants recognize that, although students with disabilities manage well on their own, teaching staff can further facilitate their studies. This aims to enhance the willingness of teaching staff to accommodate students with disabilities.

Both are elements of empathy:

Despite its acknowledged importance for human social systems, empathy lacks a clear definition. Generally, however, empathy is understood to encompass the ability to understand another person's emotions, i.e. the ability to put oneself in their position (Gerdes et al., 2010). This is reflected by the first objective. Furthermore, some definitions add that empathy involves responding to the recognition of emotions with appropriate reactions. This is reflected by the second objective.

Empathy can be challenging to distinguish from sympathy. Empathy should not evoke an emotional reaction, whereas sympathy is described as "feeling sorry" (Gerdes et al., 2010).

This distinction is relevant for this work because, by design, none of the game's objectives encompasses players feeling pity for students with disabilities.
According to Gerdes et al. (2010), the three main categories of measuring empathy are:

3) Physiological Methods
2) Behavioral Observational Methods
1) Self-Report

3) Physiological Methods

Physiological methods include neurological measurements of the nervous system, such as MRI and ECG. These were excluded due to the complexity and feasibility concerns within the context of this work.

2) Behavioral Observational Methods

In these methods, participants' reactions to emotional scenarios are observed, such as evaluating their empathy based on how they interpret the emotions of other individuals depicted in comics. Behavioral observational methods were not included in this study due to the complexity that the variability in participants' reactions would introduce in data collection and analysis. Instead, the focus was on quantitative assessments and structured feedback, ensuring a more controlled process.

1) Self-Report

Self-report is the easiest and most frequently used method among the three categories for measuring empathy and is thus deemed appropriate for the context of this work. It involves questionnaires designed to assess empathy. Numerous versions have been developed over the decades, including, but not limited to:

The Empathy Scale (Hogan, 1969): The Empathy Scale by Hogan (1996) was one of the first widely used empathy questionnaires. It contains four dimensions:(1) social self-confidence, (2) even-temperedness, (3) sensitivity, and (4) nonconformity. However, it was proven to have low test-retest reliability in the 2000s.

Interpersonal Reactivity Index (IRI) (Davis, 1983): The IRI consists of four subscales: (1) perspective taking, (2) fantasy, (3) empathetic concern, and (4) personal distress. While these categories try to reflect the complex nature of empathy, there is criticism that

the IRI measures imagination (2) and self-control (4) more than actual empathy. Despite this, the categories (1) and (3) are often used as the basis for new empathy questionnaires.

Empathy Quotient (EQ) (Baron-Cohen & Wheelwright, 2004): The EQ contains 60 questions, 40 of which are empathy-related and 20 control questions.

Questionnaire of Cognitive and Affective Empathy (QCAE) (Reniers et al., 2011): The QCAE contains 31 questions with a 4-item Likert scale. It is composed of items from the Empathy Scale, IRI, and EQ. However, its validity has not been confirmed through broader literature.

While issues of validity pose a concern, some questionnaires, such as the EQ and the QCAE, have also been deemed too lengthy to be used in the context of this work.

Additionally, there is a distinction between dispositional empathy, which is a stable characteristic of an individual, and situational empathy, which refers to an empathic response in a specific context. Most questionnaires focus on measuring dispositional empathy. Situational empathy, on the other hand, can only be assessed immediately after the relevant situation and cannot be measured before the situation has occurred. In the context of BlindDate, this means that a before-and-after comparison of changes in empathy would not be feasible.

Lastly, none of the aforementioned questionnaires resolves the issue that participants may misreport their own empathy levels or provide socially and morally desirable answers rather than realistic ones. This issue could be mitigated by having close acquaintances fill out the questionnaires on behalf of the participants, an approach not feasible for the present work.

Synonyms

Related concepts to "empathy" were also considered to determine if existing questionnaires might be suitable for the intended purpose.

Both "immersion" and "presence" were examined as these terms describe the extent to which a player can deeply engage with a game's character, essentially building empathy within the context of gameplay. A few questionnaires identified include:

- Immersive Experience Questionnaire (IEQ)
- Game Engagement Questionnaire (GEQ)
- Presence Questionnaire (PQ)

However, it must be acknowledged that brief, linear games like the BlindDate simulations are unlikely to induce the same level of flow or presence that these questionnaires are designed

to measure. Questions such as "To what extent did you lose track of time?" (IEQ) or "How responsive was the environment to actions that you initiated?" (PQ) are less applicable in this context. While some questions, such as "To what extent did you feel that the game was something you were experiencing, rather than something you were just doing?" (IEQ), could have been extracted, the initial objective was to identify a fully pre-existing questionnaire.

The concept of "bias" or "prejudice" was also considered as a related term to assess the general conscious and unconscious attitudes of participants towards a topic. Research determined questionnaires specifically targeting attitudes towards disabilities, such as:

- Revised Acceptance of Disability Scale
- Attitude to Disability Scale

However, these questionnaires were deemed too lengthy, especially considering that in the context of BlindDate user tests, such assessments would need to be administered separately for each disability, as well as pre- and post-simulation.

While these questionnaires represent so-called "direct" methods of measuring prejudice, the research also encountered the concept of "indirect" methods. In these methods, participants are often unaware of what is being measured, preventing them from adjusting their responses to align with social desirability or moral expectations.

Such indirect methods include those compiled by the National Disability Authority (NDA, 2022:

- **Vignette:** Participants are presented with a series of vignettes where one characteristic (e.g. disability) varies between them. Then, the differences in responses to these vignettes are measured.
- **List Experiment:** Respondents are not asked about the sensitive issue directly. Instead, they provide a count of the items on a list they agree with, which includes the sensitive item.
- **Randomized Response Method:** This method involves using a randomizing device, like a coin flip, to determine whether respondents should answer the sensitive question truthfully or provide a predetermined response.

The main issue with these indirect methods is that they are time-consuming to both carry out and analyze. Also, many of them require an exceptionally large sample size to be effective, which was not feasible within the scope of this study.

Silverman's Questionnaire

Silverman et al. (2014) designed and used a questionnaire to assess how participants rated the capabilities of blind people. They had participants indicate "how well [they] think the average blind person could do this activity, compared with the average nondisabled person" on a 7-item Likert scale:

1 = a blind person could perform the activity much worse than a nondisabled person;
4 = a blind person could perform the activity as well as a nondisabled person;
7 = a blind person could perform the activity much better than a nondisabled person.

They selected activities based on reports "that blind people face especially strong discrimination in these fields": living independently, walking around downtown, accountant, chef, construction worker, schoolteacher, small business owner, and tour guide.

Modifications

Silverman et al.'s questionnaire was borrowed and slightly modified for this work. The activities selected for this work are those that typically occur in everyday study life:

- "Can find their way around the campus"
- "Can follow an on-site lecture"
- "Can follow an online lecture"
- "Can upload a submission to the university's Learning Management System (LMS)"
- "Can write an academic paper with a bibliography"
- "Can take a written exam"
- "Can take an oral exam"

It was discussed whether the questions should be phrased in a way that certain impairments are mentioned, similar to Silverman's approach of rating a "blind person". In the context of BlindDate and its simulation games, this would mean referring to "students with visual impairments", "students with hearing impairments", and "students with psychological impairments". Alternatively, the questions could be framed generically as "students with disabilities". It was decided to use the specific impairments. This way, it is possible to assess whether the three games have varying effects on the participants' perception of the different student groups.

"A student with disabilities can follow an on-site lecture" vs.
"A student with a visual impairment can follow an on-site lecture"

It was debated whether the questions should be expressed in the first or third person singular. Silverman uses the third person, formulating her statements in the style of "A blind person could...". An alternative would be to use the first-person perspective, i.e. "if I were blind, I could...". The decision was made to retain the third person, as the use of the first person could further increase the impact bias. Batson et al. state that "imagining how someone else feels about a traumatic accident, instead of imagining how 'you yourself' would feel, produced more empathy for the individual imagined and less personal distress for the perceiver" (Batson, Early, & Salvarani, 1997).

"A student with a visual impairment can follow an on-site lecture" vs.
"If I was a student with a visual impairment, I could follow an on-site lecture"

Another decision was whether the time since the impairment has persisted should be specified in the question, i.e. whether the participant should receive information about whether the person has been impaired for a long time or only recently. This was ruled out as it focuses too obviously on the adaptation of students with impairments, thereby reducing the participants' option to independently consider this aspect.

"A student who has had a visual impairment since birth can follow an on-site lecture" vs.
"A student with a visual impairment can follow an on-site lecture"

Lastly, it was considered whether the questions should be framed as quantitative, closed-ended questions, to facilitate a clearer before-and-after comparison as in SIlverman's approach, or whether they should be qualitative, open-ended questions to gain a deeper understanding of potential interpretations of the questions. Ultimately, the quantitative format was retained, however, participants were encouraged to provide brief oral justifications for their responses.

The final questionnaire, customized on the basis of Silverman, presented as follows:

"How well do you think an average person with [an impairment] could perform this activity, compared to an average non-impaired person?"

Where the variable [an impairment] is replaced by the impairment depicted in the specific

game, i.e. visual impairment, hearing impairment, or psychological impairment.
The scale of possible answers for each activity comprises seven points:

O O O O O O O
1 4 7

1: A person with [an impairment] could perform the activity much worse than a non-disabled person.
4: A person with [an impairment] could perform the activity just as well as a non-disabled person.
7: A person with [an impairment] could perform the activity much better than a non-disabled person.

The aforementioned questions aimed to assess whether teaching staff had a greater awareness of students' needs after playing the games. To determine if this increased awareness would translate into a higher likelihood of addressing recognized accessibility needs, the following 7-item Likert scales were also included:

"How do you rate the following statements?:"

"I think that students with [an impairment] should be supported by teaching staff."

"I think that students with [an impairment] can feasibly be supported by teaching staff."

O O O O O O O
1 4 7

1: I do not agree at all.
7: I completely agree.

All these questions were administered both before and after the participants engaged with the games to detect any changes in their perceptions.

Qualitative Questions

The following qualitative questions were asked in addition to the quantitative measures.

Before Playing:

"What problems do students with disabilities encounter in their everyday studies?"

This question was intended as a qualitative supplement to the Likert scales inspired by Silverman, although participants were also encouraged to provide brief verbal justifications for their responses when completing the scales.

"How would you rate the effort involved in making your teaching accessible?"

This question was intended as a more subtle alternative to directly asking how likely teaching staff are to respond to a request from students.

After Playing:

"How was playing the games for you? What was good, what was bad?"

Participants were invited to provide a brief report on their experience with the games, including both positive aspects and areas for improvement. During the dialog, if relevant, they were also asked to comment on their perception of the presence of the persona and the execution of tasks, implicitly reflecting on the implementation of the guidelines.

"How did playing the game deepen your understanding of the characters?
What aspects or situations in the game contributed to this?"

This question sought to assess whether and, if so, how the games effectively allowed players to momentarily 'step into the shoes' of the students, as this is a key aspect of fostering empathy.

"What problems do students with disabilities encounter in their everyday studies?"
"How would you rate the effort involved in making your teaching accessible?"

By asking the same questions as before the game, the participants had the opportunity to consciously reflect on any changes in their opinions. Additionally, it was considered that individuals who only recite specific issues depicted within the games might not be able to effectively apply the insights gained to other disabilities, as they do not demonstrate a transfer of learning. A successful transfer could possibly be indicated by responses such as, "Students should know that they can approach me for assistance..." or "One problem is that many educators are unaware of how to...".

"Are you planning to change anything about your teaching, and if so, what?"

This question aimed to assess whether the simulations have led to actionable changes in practice, both through the theoretical recognition of barriers and the practical willingness to change them.

8.2.5 Adjustments

A trial run was conducted to test the planned evaluation method before its actual use with teachers. The goal was to determine whether it could yield meaningful results and if its duration was appropriate. To achieve this, the entire user study was conducted under realistic conditions with a single test subject, who was a 25-year-old computer science student with a modest background in teaching musical instruments.

Consideration was given to whether including 14 items of the UEQ might be excessive, with the possibility of omitting the categories “Stimulation” or “Novelty”. However, during the trial run, the questionnaire’s length did not appear unreasonable to complete, so the original format was retained.

The Likert scales assessing the test subjects’ perception of students with impairments were slightly adapted. Previously, the seven items had been structured symmetrically, with the neutral option positioned at the midpoint.

O O O O O O O
1 4 7

1: A person with [an impairment] could perform the activity much worse than a non-disabled person.

4: A person with [an impairment] could perform the activity just as well as a non-disabled person.

7: A person with [an impairment] could perform the activity much better than a non-disabled person.

Since the test subject did not perceive students with impairments to be superior to those without impairments in any category, the scale was adjusted to increase detail on the negative side. This modification aimed to capture more differentiated results.

O O O O O O O
1 5 7

1: A person with [an impairment] could perform the activity much worse than a non-disabled person.

5: A person with [an impairment] could perform the activity just as well as a non-disabled person.

7: A person with [an impairment] could perform the activity much better than a non-disabled person.

The test subject took 40 minutes to complete the study, which was subsequently provided as a guideline for future participants. The results obtained during the test run were not used in the final evaluation.

8.2.6 Procedure

The user study was conducted with one test subject at a time. It was done in an online format, using the video conferencing tool "Big Blue Button" [36], which was provided by the author's university. The study was conducted in German, with all content subsequently translated for this work.

In the beginning, each test subject was asked for their informed consent and briefed on the user study's procedure and goal, before they received a link to the questionnaire via chat. The questionnaire was implemented in "HdMSurvey" [37], a data protection friendly installation of "LimeSurvey" [38] on the author's university's servers. This anonymized questionnaire guided the test subject through the entire study, providing digitally fillable quantitative questions, links to access the games, and indications of when an oral interview would take place. The test subject shared their screen, so that their doing could be observed, and was asked to "think aloud"[39], i.e. verbalize their thoughts as they acted, which allowed for a better understanding of their thought processes. The user study itself consisted of ten steps:

1. Collection of demographic data
2. Introduction of the BlindDate personas
3. Pre-Play-Survey
4. Pre-Play-Interview
5. Playing the first game
6. Assessing the first game
7. Playing the second game
8. Assessing the second game
9. Post-Play-Survey
10. Post-Play-Interview

[36] https://bigbluebutton.org/
[37] https://survey.hdm-stuttgart.de/
[38] https://www.limesurvey.org/de
[39] https://www.nngroup.com/articles/thinking-aloud-the-1-usability-tool/

In the second step, the person conducting the user study briefly introduced the three personas, “Hannah”, “Gabriel”, and “Maxi”. This was done to ensure that all test subjects had identical foundational knowledge and could reference the personas when being asked questions about students with disabilities. However, the test subjects were allowed to respond based on their prior knowledge if they preferred. In the typical use of BlindDate, it is realistic to expect that users first review the persona’s page before engaging with the embedded game.

The introduction of each persona included the following details:

- Name
- Age
- Field of study
- General and specific impairment
- An excerpt from the BlindDate text describing their strategies for studying

In the third step, a survey was conducted to capture test subjects’ initial perceptions of students with disabilities. The questions specifically targeted the two students whose games the respective subject would play. In the fourth step, the corresponding qualitative interview questions were posed. The assessment of the games in the sixth and eighth steps included the User Experience Questionnaire (UEQ) as detailed in chapter 8.2.2 and the knowledge questions as detailed in chapter 8.2.3, and was conducted immediately after playing each game. In the ninth step, the test subjects again filled out the assessment questionnaire to determine if their perceptions had changed after playing the games. In the tenth step, the corresponding interview questions were posed again. The user study concluded with a note of thanks to the test subject.

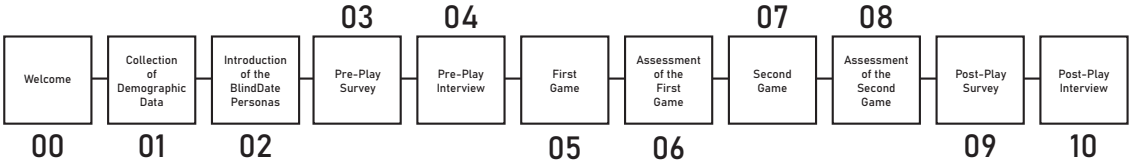


Figure 22: Procedure of the Study

A pre-test and post-test design with the same participants was employed instead of a control group due to the small sample size. Each participant played two out of three games: One featuring a physical impairment (Gabriel, Hannah) and one featuring a mental impairment (Maxi). Having each participant play all three games was deemed too time-consuming, while limiting participants to only one game would have needed a large sample size. Additionally, the games for Gabriel and Hannah, both of which portray physical impairments, are

structurally and thematically similar. To ensure balance, the games were alternated across four different modes: Maxi-Hannah, Maxi-Gabriel, Gabriel-Maxi, and Hannah-Maxi. Participants who played the first game would likely navigate the second game more easily. Even though the texts and specific mechanics differ, the underlying pattern remains the same, which participants may subconsciously recognize.

8.2.7 Participants Eligibility Criteria

The user study primarily targeted teaching staff at higher education institutions, as they represent the main target group of the BlindDate platform. Teachers at secondary schools were included to broaden the participant pool, given the difficulty in recruiting exclusively higher education level faculty. Teacher students as well as retired teachers from the aforementioned school forms were eligible for participation. Participants from elementary schools, music schools, or similar institutions were excluded due to their teaching contexts being considered too divergent from the BlindDate platform's focus. As the user study was conducted online, participants necessarily needed an internet-connected computer, speakers, and a microphone. Only participants of legal age and capable of giving consent were invited. Recruitment was carried out by sending circular mails to various universities.

8.3 Post-Study

A post-evaluation was conducted at the ICCHP Conference, which was held in Linz, Austria, from July 10th to July 12th, 2024. In this context, a two-hour-long workshop, titled "Towards a Manifesto on Effective Disability Simulations: Navigating Benefits and Risks. Experiences and Lessons Learned from Companies and Universities." was led by the author of this work in collaboration with colleagues. One goal was to identify possible further research as an outlook for this work. Following an introduction and participant introductions, several presentations were held. The workshop included 15 experts in the field of accessibility, some of whom attended spontaneously, while others had been invited specifically for the event. No people with disabilities were present. The invited experts prepared short presentations related to the overarching theme of "Disability Simulations" and shared their work with those attending.

The author presented her derived guidelines and findings to date. At that stage, few user tests had been conducted but were not yet fully analyzed, and few user tests were still pending completion.

After each presentation, a qualitative discussion took place, including one following the author's presentation. During this discussion, the author posed the question, "Why do players of my disability simulations not perceive the students as more capable after playing the

games?" and suggested a possible solution that this might be due to the short duration of the simulation. Qualitative statements from the experts during this discussion were noted.

To provide a quantitative element, a small poll was conducted. This was done using "Mentimeter"[40], chosen for its accessibility features. The poll included three questions, each addressing one of the presented guidelines. The wording for each question was: "The guideline [name of the guideline] is well suited". Participants then responded using a 6-item Likert scale ranging from 1 (strongly disagree) to 6 (strongly agree), with 2 and 3 indicating progressively weaker disagreement, and 4 and 5 indicating progressively stronger agreement.

In addition, the poll included the option to anonymously answer the following questions, which were also part of the oral discussion: "What additional guidelines could be suitable?" and "How could the evaluation process be improved?"

9 Results

9.1 Participants

Ultimately, the study was conducted with nine test subjects, consisting of five women and four men. They are aged between 28 and 62 years, with an average age of 35 years.

All test subjects are working as teaching staff based in Germany. Among them, five teach at higher education institutions, including one at a university of applied sciences and one at a pedagogical university. Three test subjects are teachers at grammar schools, and one is a teacher at a secondary school. The disciplines they teach include: German, Spanish, Latin, Religion, Mathematics, Physics, Computer Science (3 test subjects), Economics (2 test subjects), and Accessibility (1 test subject). The number of disciplines taught by each individual varies from one to three.

Six of the nine participants had never heard of BlindDate. The other three were vaguely familiar with the concept, having been introduced to it in a presentation, but had not personally used the platform.

Two participants reported that they had no knowledge of digital accessibility. Three participants indicated they had little knowledge, while three rated their knowledge as average. None of the participants considered their knowledge to be above average. One participant, an educator in the field of accessibility, rated their knowledge as very good.

The following table displays the frequency of each combination of the three games played by the participants:

[40] https://www.mentimeter.com/

Gabriel/Maxi	Maxi/Gabriel	Hannah/Maxi	Maxi/Hannah
3x	2x	2x	2x

Overall, the game about Hannah was played by 4 participants, the game about Gabriel by 5 participants, and the game about Maxi by all 9 participants.

The test subjects were not compensated for their participation.

9.2 Attractiveness

Mean

The games were generally evaluated positively across all dimensions.

	Hannah	Gabriel	Maxi
Attractiveness	1,542 (best)	1,200 (2nd)	0,556 (3rd)
Stimulation	2,375 (best)	2,150 (2nd)	2,028 (3rd)
Novelty	2,313 (best)	1,600 (3rd)	2,278 (2nd)

Both the games about Hannah and Gabriel reached positive scores in Attractiveness, Stimulation, and Novelty, with positive being defined by the UEQ standard interpretation as scores above 0.8. In contrast, while the game about Maxi also achieved positive ratings for Stimulation and Novelty, this game's Attractiveness score of 0.556 falls within the "neutral" range.

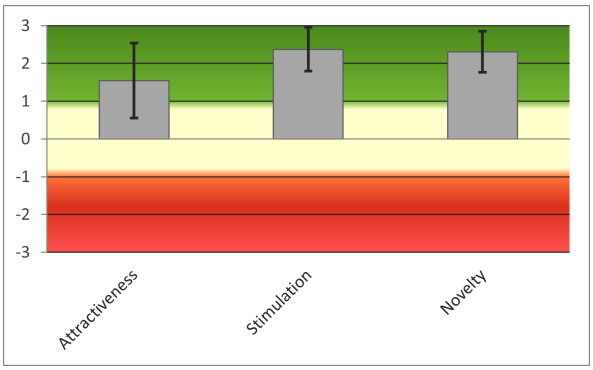


Figure 23: UEQ Graph of Hannah

The game about Hannah outperformed the other games in all three dimensions, recording the highest scores for Attractiveness (1.542), Stimulation (2.375), and Novelty (2.313). This

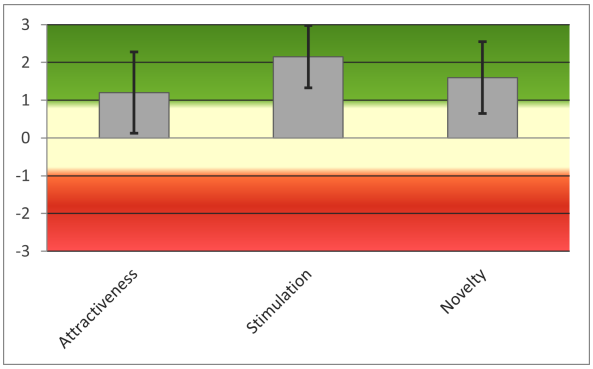


Figure 24: UEQ Graph of Gabriel

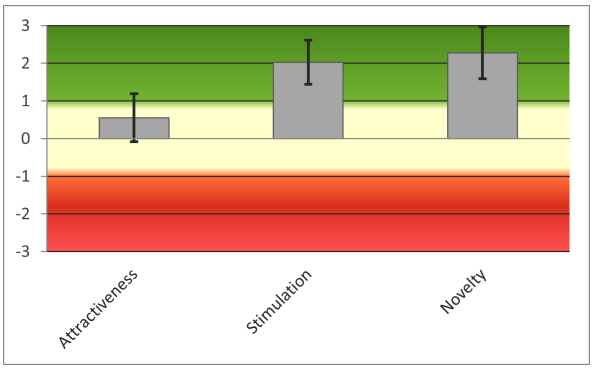


Figure 25: UEQ Graph of Maxi

suggests that Hannah's game provides the best overall user experience. The game about Gabriel ranked second in Attractiveness (1.200) and Stimulation (2.150), whereas the game about Maxi placed second in Novelty (2.278).

Variance

The lowest variance observed was 0.31 for the Novelty of Hannah's game.
The highest variance observed was 1.52 for the Attractiveness of Gabriel's game.

	Hannah	Gabriel	Maxi
Attractiveness	1,03	1,52 (highest)	0,95
Stimulation	0,35	0,89	0,80
Novelty	0,31 (lowest)	1,18	1,12

Overall, participants tended to exhibit greater consensus in areas that received high ratings.

Hannah's Stimulation and Novelty, as well as Gabriel's and Maxi's Stimulation, showed mean values exceeding 2 and variances below 1. This low variance in high-rated areas suggests that these aspects of the games are generally positively perceived.

The highest variance was observed in Gabriel's Attractiveness, followed by Gabriel's and Maxi's Novelty, and then Hannah's and Maxi's Attractiveness. The high variance indicates significant variability in how participants perceive these aspects. It further impacts the reliability of the mean ratings, making them less representative.

The Sample Size Estimator provided by UEQ indicates that given the high variance observed for Attractiveness, a larger sample size would be necessary to reduce it and achieve more precise results. For instance, for the Hannah game, to attain a precision of 0.25 with an error probability of 0.1, 45 participants would be required. To achieve a higher precision of 0.1 with the same error probability, the sample size would need to increase to 279 participants.

In contrast, for Stimulation and Novelty, lower sample sizes were sufficient due to their lower standard deviations. Specifically, for a precision of 0.25 and an error probability of 0.1, only 15 participants were needed for Stimulation and 13 for Novelty. For a higher precision of 0.1, the required sample sizes were 96 for Stimulation and 84 for Novelty.

Due to the low sample sizes in the study, significance tests were not performed.

Benchmark

To benchmark the measured user experience of the product against other established products, the UEQ provides a reference with 452 product evaluations and 20,190 participants in the latest version at the time of this work.

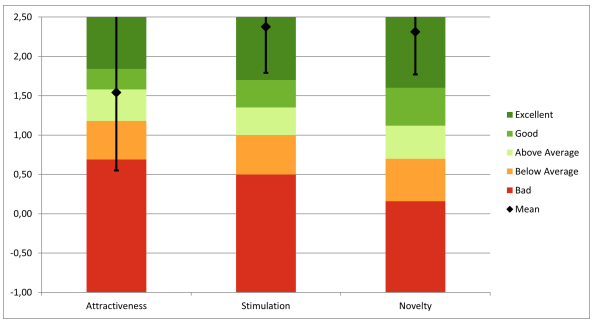


Figure 26: UEQ Benchmark of Hannah

Hannah, who internally ranked highest in all categories, achieved "Excellent" ratings for Stimulation and Novelty in the benchmark comparison, placing her results among the top 10% of evaluated products. The confidence intervals support this, as they fall entirely within the

excellent range. For Attractiveness, Hannah's rating is near the threshold between "Good", where 10% of benchmark results are better and 75% are worse, and "Above Average", where 25% of results are better and 50% are worse. However, the confidence interval for Attractiveness is quite broad, extending into the "Bad" range, which includes the bottom 25% of results.

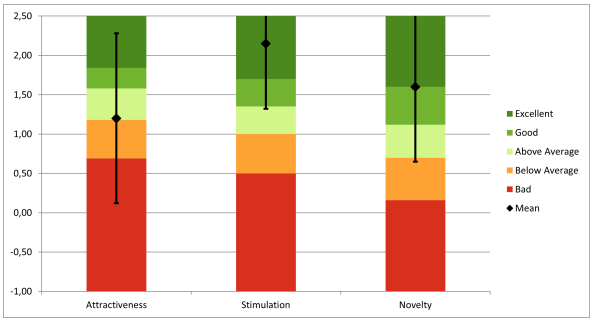


Figure 27: UEQ Benchmark of Gabriel

Gabriel's results show a similar pattern. In terms of mean values, all three categories fall into favorable ranges of the benchmark: Stimulation is rated as "Excellent", Novelty is on the boundary between "Excellent" and "Good", and Attractiveness is classified as "Above Average". The confidence interval for Stimulation remains within the excellent range. For Novelty, the confidence interval spans from "Below Average" to "Excellent". The interval for Attractiveness extends from "Bad" to "Excellent".

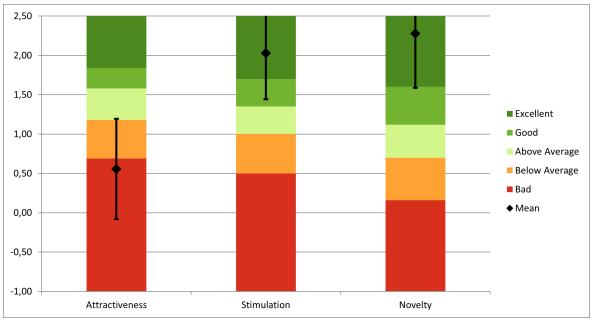


Figure 28: UEQ Benchmark of Maxi

Lastly, Maxi's ratings are "Excellent" for both Stimulation and Novelty, with confidence intervals extending down to "Good". In contrast, the mean value for Attractiveness is in the "Bad" range, although the confidence interval reaches up to the lower boundary of "Above Average".

Commentary

In general, it could be conccluded from the verbal statements that participants often selected the midpoint on the 7-item Likert scale when they were unsure how to interpret a given word pair. Additionally, one participant mentioned that they were unable to assess certain aspects due to the limited amount of content provided.

Attractiveness The large variability in the Attractiveness ratings for all three games can be explained by the qualitative feedback provided by participants. Verbal statements showed that participants interpreted terms such as "enjoyable", "pleasant" and "attractive" differently in the context of the games.

For example, while one participant found the games well-designed, they considered the game content itself as annoying. One participant reported that it was annoying to have an impairment in general, while another one thought it was annoying to be forced to take so many breaks in the specific game about Maxi. One participant expressed that they were annoyed when they had to guess during the second task and were unable to get it right.

Another participant mentioned the same aspect about the second task in the context of the word "unpleasant". This term was further used to describe the panic attack in Maxi's game - specifically the sound of the loud heartbeat, which was mentioned by several participants -, as well as the feeling of restriction, and the overall gaming experience of all games.

Some participants themselves pointed out that these terms could be interpreted ambiguously. For instance, one participant noted that the game about Maxi was occasionally unpleasant but became more pleasing once a panic attack had ended. Another participant stated that the games generally became more pleasant as they progressed. Additionally, one participant remarked that while the barriers encountered in the game were unpleasant, the strategies provided to overcome these barriers were pleasing.

However, some participants also interpreted these terms positively. One participant found the game design attractive and expressed that it was enjoyable to have experienced the game. Another participant described it as pleasing to engage with the topic of the games. Additionally, one participant found it enjoyable that the game provided an opportunity to empathize with the experiences of impaired students.

Lastly, three participants used these terms to compare two of the games. One participant found the game about Gabriel more enjoyable than the one about Maxi, as they preferred the theme of the virtual lecture. Two participants described the game about Maxi as more unpleasant than the one about Gabriel. One of these participants found the panic attack to be a generally more distressing situation compared to the visual impairment. The other

participant noted that although both games involved moments where the player's vision was impaired, they found it less troubling in Gabriel's game, as such a mechanic was expected in a game about visual disability. In contrast, to them, it was unpleasantly surprising in Maxi's game.

Stimulation The comments regarding the Stimulation aspect of the three games were more consistent, reflecting the similarly uniform values observed in the UEQ. Two participants expressed that the content presented in the games was interesting and that they were able to learn something valuable for their own teaching. Two other participants described the games as valuable because they allowed them to perceive the perspectives of students with impairments. One participant found the game about Gabriel particularly motivating, as they enjoyed the game mechanic of looking through a small hole. Only one qualitative comment on Stimulation was slightly negative: A participant noted that the initial excitement diminished somewhat as the games progressed.

Novelty There were only a few comments regarding the Novelty of the games. Two participants each described the game about Maxi as more inventive than the other game they had played, one comparing it to Hannah's game and the other to Gabriel's game. One of these participants explicitly mentioned that the mechanics used in Gabriel's game are more commonly seen, whereas the mechanics in Maxi's game were more unique. Conversely, another participant explicitly referred to the mechanic in Gabriel's game as exceptionally creative.

9.3 Knowledge

The following tables show how the test subjects scored on the knowledge questions about the individual personas.

Hannah:

Statement	Type	Subject 2	Subject 4	Subject 6	Subject 8
'Automatically generated subtitles often only match what is said to a limited extent.'	Playable	x	x	x	x
'Teachers have the option of correcting automatically generated subtitles manually.'	Playable	x	x	x	x
'A buzzing noise is not a realistic representation of Hannah's hearing impairment.'	Readable		x	x	
'Automatically generated subtitles are by now widely available.'	Readable	x	x	x	x
'In addition to subtitles, a clearly visible mouth image in lecture videos is also important for Hannah.'	Non-Content				
'Speech recognition software often works better when people are speaking English.'	Non-Content				
'A translation into sign language is generally a good alternative to subtitles.'	Wrong				

Gabriel:

Statement	Type	Subject 1	Subject 2	Subject 5	Subject 7	Subject 9
'As he can't see everything, Gabriel has to search for individual elements on a slide first.'	Playable	x	x	x	x	x
'Despite his head movement strategy, Gabriel works more slowly than other students.'	Playable	x	x	x	x	x
'Constantly moving his head can cause Gabriel neck pain.'	Readable	x	x	x	x	x
'Gabriel's head movements can seem strange to outsiders.'	Readable				x	x
'As an alternative to head movements, Gabriel can use a screen reader.'	Non-Content					
'In addition to the visual field impairment, Gabriel has difficulty recognizing contrasts due to glaucoma.'	Non-Content					
'A standardized slide design makes additional alternative texts for pictures obsolete.'	Wrong	x				x

Maxi:

Statement	Type	1	2	3	4	5	6	7	8	9
‘During a panic attack, Maxi often no longer sees or hears their surroundings properly.’	Playable	x	x	x	x	x	x	x	x	x
‘Lecture videos allow students to interrupt their learning if necessary.’	Playable	x	x	x	x	x	x	x	x	x
‘Maxi’s panic attacks sometimes just happen, even under the best conditions.’	Readable	x	x	x	x	x	x	x	x	
‘When Maxi has a panic attack in public, they are embarrassed.’	Readable	x	x	x		x	x	x		
’The isolation that asynchronous teaching entails can also have negative effects.’	Non-Content									
‘At the beginning of a lecture video, a warning about sensitive content, so-called ‘triggers’, should be given.’	Non-Content									
‘Depression usually subsides after six to eight weeks.’	Wrong									

The evaluation of the knowledge questions verifies the hypothesis that the players internalize the learning content better when they experience it themselves as playable mechanics. All nine test subjects correctly ticked all statements of the “Playable” type for the games they played. At two points, test subjects made additional oral remarks to the effect of “I have experienced that myself during play” while filling out the questionnaire. Once for the statement “Despite his head movement strategy, Gabriel works more slowly than other students” from the game about Gabriel, and once for the statement “Automatically generated subtitles often only match what is said to a limited extent” from the game about Hannah. There were no such remarks for the game about Maxi, however, the test subjects were not explicitly asked about it, either.

The acquisition of knowledge through reading texts in the game was slightly lower:

In the game about Hannah, two out of four test subjects did not know that “a buzzing noise is not a realistic representation of Hannah’s hearing impairment”. Hannah makes this statement in the course of the seventh task, i.e. the second task that the player fulfills with their strategy being supported by the teacher. Qualitative observations showed that the subjects in question solved the tasks particularly quickly at this point because they were now able to do so without having to spend time deciphering the subtitles. In their haste, they

evidently skipped reading the texts.

In the game about Gabriel, three out of five test subjects did not realize that "Gabriel's head movements can seem strange to outsiders". Gabriel makes this statement in the course of the third task, i.e. the first task which the player fulfills with the help of Gabriel's strategy, but still without the help of teachers. It can be assumed that, at this stage of the game, the players were so mentally preoccupied with the suddenly cumbersome solving of the task, that they were unable to take in any other information. The statement "Constantly moving his head can cause Gabriel neck pain", which is made in the directly following fourth task, when the player has already become accustomed to the mechanics, was again ticked correctly by all test subjects.

The false statement in the game about Gabriel, "A standardized slide design makes additional alternative texts for pictures obsolete", turned out to be a trap for some players. Two out of five test subjects explicitly stated that while the game covered the topic of standardized slide design, alternative texts were not mentioned. However, two test subjects ticked this statement incorrectly. It is unknown whether they simply did not read the statement carefully enough or actually drew wrong conclusions from it.

In the game about Maxi, two out of nine test subjects did not know that "when Maxi has a panic attack in public, they are embarrassed", which is mentioned in the third task, when the strategy of taking breaks is introduced. One of these two test subjects further did not know that "Maxi's panic attacks sometimes just happen, even under the best conditions", which is mentioned in the fifth task.

In seven instances, test subjects made additional oral remarks to the effect of "The persona mentioned this" while ticking statements of the "Readable" type. In an eighth instance, one subject made this remark for a statement that was of type "Playable", but appeared in the text as well, suggesting that they acquired the knowledge mainly by reading. This was for the statement "Teachers have the option of correcting automatically generated subtitles manually" from the game about Hannah.

In two cases, players justified their selection of certain statements based on the game mechanics they had experienced, although these were not, in fact, statements of the "Playable" type. One player of the Gabriel game correctly decided not to tick the statement "In addition to the visual field impairment, Gabriel has difficulty recognizing contrasts due to glaucoma", stating that this could not be true since the contrasts of the fictional slides had not changed during the simulation. One player of the Hannah game correctly ticked the statement "Automatically generated subtitles are by now widely available", stating that automatically generated subtitles must be very common, otherwise, Hannah would not have been able to activate them in the game. This knowledge could also have been acquired by reading.

9.4 Empathy

9.4.1 Quantitative Questions on Perception

Hannah

Hannah

A person with a hearing impairment can...

...find their way around the campus.	Before Play	After Play	
Subject 2	5	5	→
Subject 4	4	4	→
Subject 6	5	5	→
Subject 8	4	4	→
		0	→

...write an academic paper.	Before Play	After Play	
Subject 2	5	5	→
Subject 4	5	5	→
Subject 6	5	5	→
Subject 8	5	5	→
		0	→

...follow an on-site lecture.	Before Play	After Play	
Subject 2	3	2	↓
Subject 4	3	3	→
Subject 6	3	3	→
Subject 8	3	2	↓
		-2	↓

...take a written exam.	Before Play	After Play	
Subject 2	5	5	→
Subject 4	5	5	→
Subject 6	5	5	→
Subject 8	5	4	↓
		-1	↓

...follow an online lecture.	Before Play	After Play	
Subject 2	3	3	→
Subject 4	4	4	→
Subject 6	5	3	↓
Subject 8	4	3	↓
		-3	↓

...take an oral exam.	Before Play	After Play	
Subject 2	3	3	→
Subject 4	1	2	↑
Subject 6	3	3	→
Subject 8	4	2	↓
		-1	↓

...upload a submission to the LMS.	Before Play	After Play	
Subject 2	5	5	→
Subject 4	5	5	→
Subject 6	5	5	→
Subject 8	5	5	→
		0	→

Improved Perception	1	3.57%
Unchanged Perception	21	75.00%
Decreased Perception	6	21.43%

Figure 29: Change of Perception through playing Hannah's Game

Four participants played the game about Hannah. Multiplied by the seven statements designed to assess the perceived capability of students with disabilities in various situations, a total of 28 assessments were made.

When analyzing these 28 assessments, the majority of perceptions remained unchanged both before and after playing the game. In 21 out of 28 cases (75%), participants rated the students' capability in the same way after playing the game as they did before. In six instances (21.43%), the perception of capability worsened: Four cases saw a decrease of one point, while two cases saw a decrease of two points. Only one instance showed an improved

rating, with an increase of one point. This positive change occurred in the statement category "A person with a hearing impairment can... take an oral exam".

Looking at the statements collectively, i.e. their summed ratings, it becomes evident that in three instances, all participants consistently maintained their original opinions. These statements were: "A person with a hearing impairment can... find their way around the campus", "...upload a submission to an LMS", and "...write an academic paper".

Notably, for the statements about uploading to an LMS and writing a paper, all participants initially gave a score of 5, indicating that they believed the person with a disability could perform these tasks just as well as a person without a disability. This perception remained unchanged. For the statement about navigating the campus, two participants gave a rating of 4, indicating that the person with a disability could perform this slightly worse than a person without a disability, however, this perception also remained constant.

In the other four statements, at least one participant's perception worsened per statement, leading to an overall negative change in the summed scores. The most significant decline occurred with the statement "A person with a hearing impairment can... follow an online lecture", which showed a total decrease of 3 points, with one participant decreasing it by 1 point and another by 2 points. This was followed by "...follow an on-site lecture", with a total decrease of 2 points, contributed by two participants each lowering their rating by 1 point.

Although there was one positive change in the "...take an oral exam" statement, where a participant increased their rating by 1 point, another participant in the same category decreased their rating by 2 points. As a result, the overall rating for this category still showed a net negative change of -1.

Some participants verbally explained their ratings. While were not forced to do so, they were encouraged.

During the pre-game questionnaire, one participant perceived navigation on campus as relatively straightforward for Hannah, except in cases where there might be announcements.

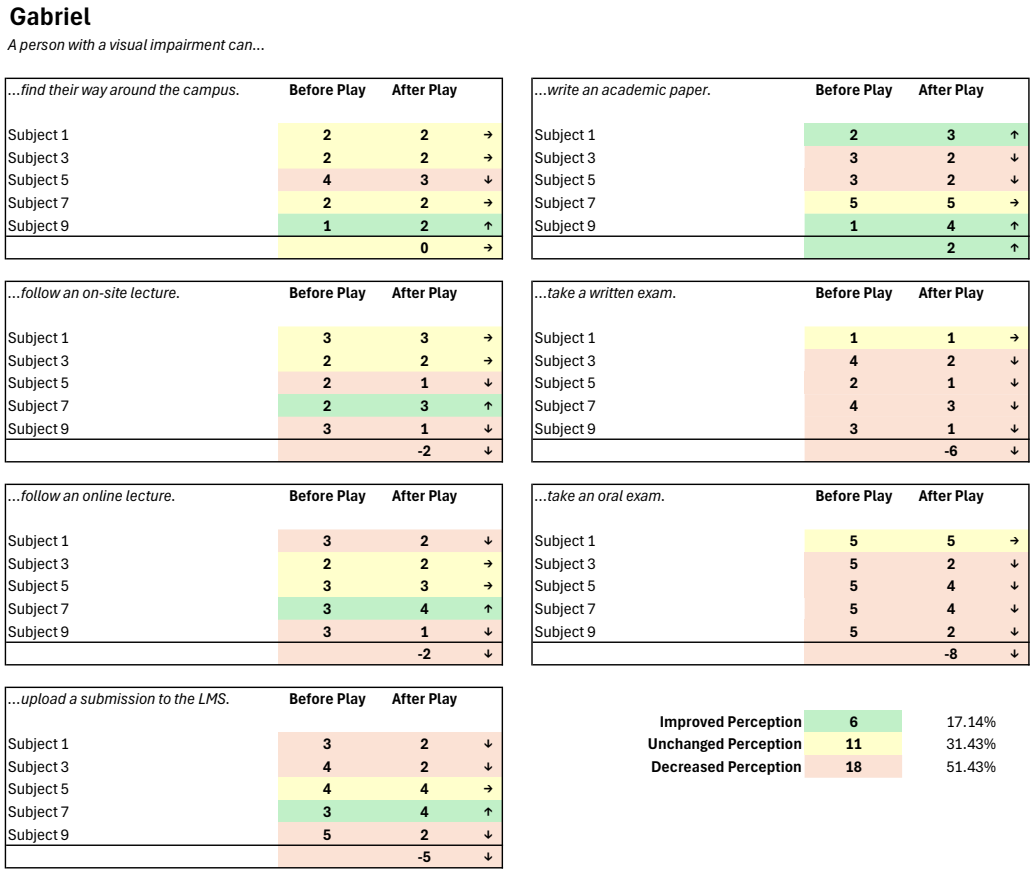
Two participants rated Hannah's ability to participate in a written exam lower than her ability to take an oral exam. They reasoned that during an oral exam, she might struggle to understand questions or follow-up questions, or her own speech might present challenges respectively. After playing the game, one of these participants maintained both scores, while the other slightly improved their rating of Hannah's capability to take oral exams.

Two participants noted that an online lecture would be easier for Hannah than an on-site lecture, stating the possibility to adjust the volume on a personal device, or the fact that there is less overlapping speech. However, after playing the game, one of these participants downgraded their rating for the online lecture to match the in-person lecture, stating that

an online lecture might be more difficult than initially thought if the subtitles are poor.

One participant mentioned that they had previously worked with a student with a hearing impairment and found it easy to accommodate them by simply wearing a microphone. However, they also recognized the burden on the student to continually approach lecturers for accommodations. This led to a relatively low rating for in-person lectures, which further decreased after playing the game. Another participant independently pointed out that in in-person lectures, the burden is often on the student to request accommodations from the teaching staff.

Gabriel



Gabriel

A person with a visual impairment can...

...find their way around the campus.	Before Play	After Play	
Subject 1	2	2	→
Subject 3	2	2	→
Subject 5	4	3	↓
Subject 7	2	2	→
Subject 9	1	2	↑
		0	→

...write an academic paper.	Before Play	After Play	
Subject 1	2	3	↑
Subject 3	3	2	↓
Subject 5	3	2	↓
Subject 7	5	5	→
Subject 9	1	4	↑
		2	↑

...follow an on-site lecture.	Before Play	After Play	
Subject 1	3	3	→
Subject 3	2	2	→
Subject 5	2	1	↓
Subject 7	2	3	↑
Subject 9	3	1	↓
		-2	↓

...take a written exam.	Before Play	After Play	
Subject 1	1	1	→
Subject 3	4	2	↓
Subject 5	2	1	↓
Subject 7	4	3	↓
Subject 9	3	1	↓
		-6	↓

...follow an online lecture.	Before Play	After Play	
Subject 1	3	2	↓
Subject 3	2	2	→
Subject 5	3	3	→
Subject 7	3	4	↑
Subject 9	3	1	↓
		-2	↓

...take an oral exam.	Before Play	After Play	
Subject 1	5	5	→
Subject 3	5	2	↓
Subject 5	5	4	↓
Subject 7	5	4	↓
Subject 9	5	2	↓
		-8	↓

...upload a submission to the LMS.	Before Play	After Play	
Subject 1	3	2	↓
Subject 3	4	2	↓
Subject 5	4	4	→
Subject 7	3	4	↑
Subject 9	5	2	↓
		-5	↓

Improved Perception	6	17.14%
Unchanged Perception	11	31.43%
Decreased Perception	18	51.43%

Figure 30: Change of Perception through playing Gabriel's Game

Five participants played the game about Gabriel. Given the seven statements designed to assess the perceived capability of students with disabilities in various situations, a total of

35 assessments were made.

When analyzing these 35 assessments, it is evident that the majority of participants' perceptions worsened after playing the game. In 18 out of 35 cases (51.43%), participants rated the capabilities of the students more negatively after playing the game than they did before. These declines ranged from -1 to -3 points, with -1 occurring 10 times, -2 occurring 5 times, and -3 occurring 3 times. The largest decreases of -3 were observed in the statements "...upload a submission to an LMS" (1 instance of -3) and "...take an oral exam" (2 instances of -3).

In 11 cases (31.43%), the participants' opinions remained unchanged. However, in 6 cases (17.14%), their perceptions improved. These improvements were noted in the categories "...find their way around the campus", "...follow an on-site lecture", "...follow an online lecture", "...upload a submission to an LMS", and "...write an academic paper", with the last category on writing a paper showing two instances of perceived improvement. The improvements ranged from +1 (5 instances) to +3 (1 instance), with the +3 occurring in the category on writing a paper.

When examining the statements collectively, i.e., by their summed ratings, there is a clear trend of worsening perceptions in 5 out of the 7 categories. The declines ranged from -2 to -8, with the greatest decrease of -8 observed in the "...take an oral exam" category, followed by a -6 decrease in the "...take a written exam" category.

One category, "...find their way around the campus", showed a stable overall score. In this case, one participant reported an improvement while another reported a decline, balancing each other out. The only category that showed an overall improvement was "...write an academic paper", with a total increase of 2 points.

Some participants verbally explained their ratings. In the pre-game questionnaire, three participants expressed that an online lecture would likely be easier for Gabriel than an on-site lecture. Their reasoning was that Gabriel could adjust the slides on his own device, such as by increasing magnification and contrast. This insight came from the initial introduction to the personas at the beginning of the user test. One participant extended this reasoning to other scenarios, stating that all digital content, including uploading assignments to an LMS and writing papers on a computer, would be easier due to the ability to make adjustments on his personal device.

Two participants initially stated that they saw few disadvantages for Gabriel in many of the scenarios, aside from the fact that he works more slowly than non-impaired students. In the post-game questionnaire, one of these participants added a new aspect they had learned from the game, noting that all these tasks are more challenging because Gabriel not only works more slowly but also experiences neck pain. This participant rated Gabriel's capabilities lower

in 5 out of 7 categories in the second survey compared to their initial assessment.

Two participants commented on campus navigation in the pre-game survey. One mentioned that it depends on whether the campus has a guidance system. The other suggested that navigation might only be a problem for students with a recent visual impairment, as they would eventually become accustomed to the pathways.

Two participants discussed written exams and shared the same opinion. They acknowledged that content could be enlarged to allow a student like Gabriel to complete exams effectively. However, they noted that the burden is on the student to request such accommodations, which they viewed as a difficulty.

One participant raised concerns about the accessibility of external digital materials not produced by the lecturers. They expressed hope that an LMS is legally required to be accessible and initially awarded a high score in this category, which they later downgraded after playing the game. At the same time, they expressed concern that literature sources from publishers might not be accessible, resulting in a moderate initial score for the paper-writing task, which they also downgraded after the game.

One participant mentioned that there are likely many assistive technologies available for a disability like Gabriel's, in contrast to other types of impairments.

Maxi

A person with a mental impairment can...

...find their way around the campus.	Before Play	After Play	
Subject 1	5	5	→
Subject 2	5	5	→
Subject 3	3	3	→
Subject 4	4	4	→
Subject 5	2	2	→
Subject 6	5	5	→
Subject 7	3	3	→
Subject 8	5	5	→
Subject 9	5	2	↓
Sum		**-3**	↓

...write an academic paper.	Before Play	After Play	
Subject 1	5	5	→
Subject 2	5	4	↓
Subject 3	5	5	→
Subject 4	4	4	→
Subject 5	3	4	↑
Subject 6	5	5	→
Subject 7	5	5	→
Subject 8	3	2	↓
Subject 9	5	5	→
Sum		**-1**	↓

...follow an on-site lecture.	Before Play	After Play	
Subject 1	5	2	↓
Subject 2	3	2	↓
Subject 3	3	1	↓
Subject 4	3	3	→
Subject 5	3	1	↓
Subject 6	3	3	→
Subject 7	3	3	→
Subject 8	3	2	↓
Subject 9	4	2	↓
Sum		**-11**	↓

...take a written exam.	Before Play	After Play	
Subject 1	5	3	↓
Subject 2	4	2	↓
Subject 3	2	2	→
Subject 4	3	2	↓
Subject 5	2	1	↓
Subject 6	3	3	→
Subject 7	3	3	→
Subject 8	4	2	↓
Subject 9	4	2	↓
Sum		**-10**	↓

...follow an online lecture.	Before Play	After Play	
Subject 1	5	3	↓
Subject 2	2	3	↑
Subject 3	4	4	→
Subject 4	4	4	→
Subject 5	4	3	↓
Subject 6	3	6	↑
Subject 7	5	4	↓
Subject 8	4	3	↓
Subject 9	3	2	↓
Sum		**-2**	↓

...take an oral exam.	Before Play	After Play	
Subject 1	5	3	↓
Subject 2	4	3	↓
Subject 3	1	1	→
Subject 4	3	1	↓
Subject 5	2	1	↓
Subject 6	3	3	→
Subject 7	3	3	→
Subject 8	4	2	↓
Subject 9	3	2	↓
Sum		**-9**	↓

...upload a submission to the LMS.	Before Play	After Play	
Subject 1	5	5	→
Subject 2	5	5	→
Subject 3	5	4	↓
Subject 4	4	4	→
Subject 5	5	4	↓
Subject 6	3	3	→
Subject 7	4	4	→
Subject 8	5	2	↓
Subject 9	5	5	→
Sum		**-5**	↓

Improved Perception	**3**	4.76%
Unchanged Perception	**31**	49.21%
Decreased Perception	**29**	46.03%

Figure 31: Change of Perception through playing Maxi's Game

All nine participants played the game about Maxi. Given the seven statements designed to assess the perceived capability of students with disabilities in various situations, a total of 63 assessments were made.

When analyzing these 63 assessments singularly, the majority of perceptions remained unchanged both before and after playing the game. Specifically, in 31 instances (49.21%), there was no change in the participants' ratings. In 29 instances (46.03%), there was a decrease in the perceived capabilities of the students. In 3 instances (4.76%), there was an increase in the perception of students' capabilities. The decreases ranged from -1 to -3 points, with -3 occurring three times in the categories "...find their way around the campus", "...upload a submission to an LMS", and "...follow an on-site lecture". The increases ranged from +1 to +3 points, with the +3 occurring once in the category "...follow an online lecture".

However, when looking at the statements collectively, i.e., their summed ratings, all categories showed an overall negative trend. The most significant declines were in "...follow an on-site lecture", which decreased by -11 points, and "...take a written exam", which decreased by -10 points. The smallest change was observed in "...write an academic paper", with a decrease of only -1 point.

Again, some participants verbally explained their ratings. Regarding campus navigation, four participants shared their thoughts. One participant considered it challenging because Maxi might be hesitant to ask for directions if unsure. Three other participants considered it challenging due to the potential for large crowds, which could trigger claustrophobia. Two of these participants saw the same issue in crowded lecture halls, suggesting that on-site lectures could also pose a problem for Maxi. These perceptions did not change after playing the game.

The categories regarding uploading to the LMS and writing a paper were combined into a single statement by four participants. Three of them agreed that the issue lies not in the task itself, but in maintaining long-term discipline and meeting deadlines. Two of these participants did not change their opinion after playing the game, while one significantly downgraded their perception. The fourth participant expressed that Maxi is better able to complete long-term tasks, which do not require immediate action, on days when they are feeling well. However, this participant also downgraded their their perception post-play.

Before playing the game, seven out of nine participants mentioned that attending lectures would be challenging for Maxi due to concentration issues and distractions from depressive thoughts. One participant thought that online lectures might be more problematic than in-person lectures, as there are more distractions at home. Three participants thought that in-person lectures might be more problematic than online lectures because there are fewer stimuli at home - a point mentioned by one participant -, or because home is a safer environment

- a perspective shared by two participants. However, one of these three acknowledged that depressive episodes could still occur at home. Two participants recognized the ambivalence and stated that they couldn't determine whether Maxi would prefer the isolation of online learning or if it would be more difficult for them.

After playing the game, three of the previously mentioned participants expressed that on-site lectures were more challenging for Maxi than they had initially thought. All three adjusted their assessments of Maxi's ability to attend on-site lectures to a lower rating. Additionally, two of these participants also downgraded their evaluation of Maxi's ability to participate in online lectures, while one upgraded it. Two participants stated that although online lectures might work better for Maxi than on-site ones, they still believed Maxi would struggle more than students without comparable impairments.

Regarding the topic of exams, one participant mentioned in the pre-play questionnaire that exams are likely to be stressful for Maxi. Four other participants generally agreed, noting that exams are stressful for all students but probably especially so for Maxi. Among these, three participants further suggested that oral exams are even more challenging for Maxi than written exams. After playing the game, three participants noted that exam situations are even more challenging for Maxi than previously thought, as a panic attack, as depicted in the game, could also occur during an exam. All three participants downgraded their assessments of Maxi's ability to complete both oral and written exams.

In general, some of the participants' comments suggest that before playing the games, they focused their responses on the maximum potential of the portrayed groups and considered what they might be capable of in a "good phase". After playing the games, however, their judgments were more focused on the specific situations they experienced during the game.

Comparison

The table shows the overall change in perception for each participant after playing the games. Overall, participants' perception of students with disabilities worsened in 15 out of 18 cases, and improved in 3 out of 18 cases. Specifically, there was one +1 increase for Gabriel, +1 for Hannah, and +3 for Maxi respectively.

When considering the summed values, the perception of Maxi, whose game was played by all participants, was worse than the perception of the respective other persona in 6 cases. In one case, the perception of both personas worsened equally (-5), which was a comparison between Maxi and Gabriel. In two cases, Maxi's perception worsened by fewer points than the perception of the other persona. This occurred once in comparison with Hannah, where the perception of Maxi changed by +3 and Hannah by -2, and once in comparison with

	Hannah	Gabriel	Maxi
Subject 1	n/a	-1	-9
Subject 3	n/a	-8	-3
Subject 5	n/a	-5	-5
Subject 7	n/a	1	-1
Subject 9	n/a	-8	-9
Subject 2	-1	n/a	-4
Subject 4	1	n/a	-3
Subject 6	-2	n/a	3
Subject 8	-5	n/a	-10

Gabriel, where the perception of Maxi changed by -3 and Gabriel by -8.

9.4.2 Qualitative Questions on Perception

The questions regarding general issues faced by students with disabilities in their studies complement the Likert scales with further qualitative insights. The subsequent overview omits the specific problems of the described groups of students with disabilities that were already discussed in relation to the quantitative questions about the three personas.

Before

Before playing the games, the following potential issues faced by students with disabilities were mentioned.
A frequently mentioned theme focuses on the time and effort required by students with disabilities. Statements included:

- They need more time in their studies to adapt materials to their own needs.
- They need more time in their studies due to the organizational effort.
- They ultimately have to perform more in their studies compared to others, including in terms of time.
- Studying is significantly more exhausting for them.

Another theme addresses university materials and structures, including:

- They do not receive the same level of information as other students, because they are unable to perceive it.
- Some courses are not accessible due to their content.
- Some materials are not adapted to their needs.
- Some courses or materials are bureaucratically challenging to change, as they are rigidly defined by academic regulations.
- Digitalization helps with some issues, but it has not yet been fully implemented across all universities.

The last frequently mentioned theme revolves around the communication of students' needs and the awareness of others regarding those:

- Lecturers and fellow students do not expect someone to have an impairment and are therefore not prepared for it.
- Lecturers do not know that or how they can help students with impairments.
- Lecturers have 'dangerous' false knowledge about them, e.g. "all deaf students can lip read".
- Students with impairments have to "reveal" themselves to others in order to get the accommodations they need.
- They constantly have the effort to approach the teachers.
- They can be mistaken for malingerers who want to receive better grades.
- They have a weaker social environment and a harder time making friends, as they are more likely to be ostracized.

After

After playing the games, the participants added the following statements:

- One participant recognized benefits in aspects they had previously perceived only negatively (specifically: online learning).
- One participant identified new measures they could use to help students with disabilities but remained uncertain whether they could actually implement them (specifically: more frequent breaks).
- One participant mentioned that sometimes, established structures can be problematic for students with disabilities.

9.4.3 Quantitative Questions on Willingness

The questions of whether students with disabilities can and should be supported by educators during their studies were answered by all nine participants both before and after playing the games.

Responsibility

In response to the question of whether students with disabilities should be supported by lecturers, nearly all participants in 16 out of 18 instances awarded full 7 points both before and after playing the games. There were two exceptions: One participant initially rated Hannah's need for support with 5 points but adjusted it to 6 points afterward, and another participant rated Maxi's need for support with 6 points and did not change their rating.

Ability

The following are the collected responses to the question of whether students with disabilities can be supported by lecturers.

Hannah

	"should be supported"				*"can be supported"*		
	Before Play	After Play			Before Play	After Play	
2	7	7	→	2	7	6	↓
4	7	7	→	4	5	6	↑
6	7	7	→	6	7	7	→
8	5	6	↑	8	6	6	→

Figure 32: Perceived supportability of Hannah

Gabriel

	"should be supported"				*"can be supported"*		
	Before Play	After Play			Before Play	After Play	
1	7	7	→	1	5	7	↑
3	7	7	→	3	6	7	↑
5	7	7	→	5	4	6	↑
7	7	7	→	7	4	6	↑
9	7	7	→	9	3	6	↑

Figure 33: Perceived supportability of Gabriel

Maxi

	"should be supported"			"can be supported"		
	Before Play	After Play		Before Play	After Play	
1	7	7	→	6	7	↑
2	7	7	→	5	6	↑
3	7	7	→	7	7	→
4	7	7	→	6	6	→
5	7	7	→	4	4	→
6	7	7	→	5	5	→
7	7	7	→	4	5	↑
8	6	6	→	5	5	→
9	7	7	→	3	3	→

Figure 34: Perceived supportability of Maxi

Before playing the game, participants rated their ability to support Hannah in a range between 5 and 7 points. After playing, two participants did not adjust their ratings. One participant adjusted it upward by one point, while one participant adjusted it downward by one point. This was the only instance where a rating decreased across all the questions regarding the responsibility and ability to support students with disabilities.

Before playing the game, participants rated their ability to support Gabriel in a range between 3 and 6 points. After playing, all five participants adjusted their ratings upward, with one increasing by 1 point, three by 2 points, and one by 3 points.

Before playing the game, participants rated their ability to support Maxi in a range between 3 and 7 points. After playing, three out of nine adjusted their ratings upward by one point each. The other participants did not adjust their ratings.

There were some verbal comments explaining the participants' assessments.

When reading the questions about their responsibility to support students with disabilities, one participant emphatically stated that students are not to blame for their disabilities. However, when reading the question about their ability to support students with disabilities, they conceded that lecturers cannot always accommodate every student, especially when there are many participants in a course.

One participant rated the responsibility to support Maxi higher compared to the other persona, citing the higher prevalence of mental health issues among students. At the same time, they assessed the ability to support Maxi lower than the other persona.

Regarding Hannah, after playing the game one participant recognized that there are many technical possibilities for supporting students with hearing impairments, but believed that the effectiveness of these solutions might be hindered by the technical proficiency of the lecturers.

Similar comments were made regarding Gabriel. One participant commented that there is more that can be done for students with visual impairments than they initially thought.

However, they did not award the full 7 points because they were concerned that external sources and tools, which are beyond a lecturer's control, might not be accessible. Similarly, another participant acknowledged that the measures demonstrated in the game are relatively easy to implement, but still expressed doubt about whether these are the only actions required or if there might be hidden work involved. Conversely, one participant initially suspected that supporting Gabriel would be very labor-intensive. However, after playing the game, they stated that they now understand that they do not need to do it perfectly, but that every bit of help is beneficial.

Regarding Maxi, three participants mentioned before playing the game that whether a student with mental health issues can be helped depends on whether the person actually reveals themselves and wants to get help. Two participants felt that support for students with mental health issues should primarily come from social work or university services, rather than from lecturers. Another participant suggested that students with mental health issues should seek therapeutic help, implying that the support should happen more within a private setting. After playing the game, one of these participants acknowledged that while support in managing their studies can be provided to these students, it cannot extend to treating the mental health condition itself.

Additionally, three participants initially noted the problem that lecturers are not trained to handle students with mental health issues. After playing the game, one participant referred to Maxi's statement that lecturers are not therapists, and used this to justify maintaining their original rating rather than increasing it. However, one of the participants revised their oral comment, stating that they now understand that even small measures can be helpful and thus feel less reluctant about providing support.

9.4.4 Qualitative Questions on Willingness

The qualitative questions about how lecturers perceive the effort required to make their teaching accessible complement the previous quantitative questions. In the following list, responses specifically related to the context of school life rather than university life have been omitted.

Before

Three participants mentioned that they would first need to learn accessibility practices before they could begin implementing them. Similarly, three participants estimated the initial effort required to be very high. However, three of those participants also noted that over time, they would become more efficient, thus reducing the overall effort required.

One participant mentioned that it is less effort to create new materials in an accessible format from the beginning than to retroactively adapt existing ones. Another participant noted that when creating accessible materials, one engages more deeply with them, e.g. their structure, which results in the materials being improved for all students.

One participant viewed the main challenge as the need to deeply empathize with students, carefully considering where and why they might encounter barriers in the materials.

Some participants explained accessibility practices they were familiar with and considered to be relatively low-effort. They mentioned that accessibility also involves simply:

- Exporting documents to different formats with just a few clicks
- Providing documents to students in advance
- Using specific devices, such as a wearable microphone
- Communicating that students can approach them for assistance

Two participants even mentioned that some accessibility measures, such as asynchronous teaching, might actually require less effort from lecturers compared to traditional teaching methods.

However, participants also recognized limitations in how much they could make their teaching accessible and noted that:

- Some subjects simply do not work well for certain disabilities (e.g. sound design with hearing impairments).
- Different disabilities require varying levels of accommodation effort (e.g., visual impairments are more challenging to accommodate than hearing impairments).
- The effort increases with the number of students with different disabilities in the course.
- It is not possible to make teaching accessible for all types of disabilities simultaneously.
- Lecturers can only address the needs of students with disabilities if they are aware of them.

Additionally, two participants explained that implementing accessible teaching practices might require a complete overhaul of their course concepts. For example, it could mean transitioning from group tasks to individual tasks to accommodate absences or prevent confusion due to overlapping speech. They expressed that they found this potential change disappointing.

After

In the list of responses provided after playing the games, answers that merely reiterated the learnings from the games were omitted.

Two participants emphasized that they still believe it to be very challenging to make their teaching accessible. Similarly, two participants highlighted that they still believe it to be impossible to make all materials accessible for every type of disability.

Conversely, two participants reported that the effort required is lower than they originally thought. Two other participants mentioned that the key aspect is trying, even if not everything is implemented perfectly. One of them further added that one should not be afraid of accessibility.

One participant mentioned that some of the aspects learned in the games were so simple that they were surprised they had not thought of them themselves. Another participant stated that they had never considered some of these aspects. As a learning, they concluded that they will need to ask students with disabilities directly about which specific accommodations would help them.

Two participants discussed that, although they have learned about accommodation measures that are relatively low-effort, they might still face challenges in implementing them. Specifically, they identified difficulties in integrating additional breaks into a tightly scheduled academic calendar and expressed concerns about legal risks associated with recording and posting lectures online.

One participant mentioned that they learned the importance of generally demonstrating openness as a lecturer.

Regarding the adjustment of existing learning concepts, a participant concluded that while it does involve effort, differentiation is also inherently a part of good teaching.

9.4.5 Game Feedback

In addition to targeted questions designed to gather feedback from participants about the games, verbal comments made by the participants during the gameplay were also noted down and analyzed.

The explicit feedback from participants regarding the games was very positive.

For example, participants described their gaming experiences as “eye-opening”. The games themselves were characterized as “good and important” and “well designed”. Other terms used to describe the games were “memorable”, which was mentioned twice, “authentic”, “relatable”, “vivid”, “entertaining” and “coherent”.

One participant particularly praised the immersion aspect of the games. They described

their emotional reactions to the games, such as feeling nervous or frustrated alongside the personas. The impactful use of media, such as the audio track of heartbeat sounds played in the game featuring Maxi, was complimented by another participant.

The word "interesting" was used by four participants. One of them noted that the depth of information was good because it was presented in small, digestible pieces. Another participant mentioned that they learned a lot in a short amount of time. Additionally, two participants appreciated learning from a game rather than a presentation.

One participant mentioned that real experiences, such as using blindfolds or headphones, would be even more impactful because they do not require abstract thinking or a transfer of the content learned into real-world situations. However, at the same time, they praised the games for being low-threshold simulations that users can easily engage with at their own desks.

Lastly, one participant summed up the entire user test by stating that they were glad to have participated.

Mentioning of Personas

In some instances, participants mentioned the presence of the persona during the game, which implicitly evaluates the guideline "Guided". It was positively perceived, and participants verbally articulated the underlying ideas of the guideline multiple times.

One participant thought that the persona made the game more empathy-inducing, realistic, and less abstract. Four participants connected the presence of the persona to immersion, noting that the persona helped them immerse themselves in the situation.

In four instances, participants positively remarked on the fact that the persona shared their experiences from their own perspective. Concretely, one participant mentioned finding it interesting to read about what the persona thinks, feels, and perceives as an impairment. Two participants further described this as beneficial because it helped them in a novel situation they had no personal experience with, but the persona did. Similarly, another participant noted that without the persona, the game would not have conveyed the perspective of students with disabilities.

One participant described that the game would have felt less personal without the persona. Additionally, a participant noted that it was beneficial for the persona to address the user directly.

Mentioning of Tasks

In some instances, participants mentioned the tasks they had to complete during gameplay, which implicitly evaluates the "Task-Based" guideline. This was also received positively, and participants proved to subconsciously understand the purpose and meaning behind the tasks.

One participant mentioned that the tasks helped them empathize with the situation as they often assign similar tasks in their own teaching. Similarly, two other participants found the tasks realistic and nicely rooted in the everyday experiences of both students and educators, which one of them described as "relevant".

While one participant thought of themselves as more of an "explorer" type of player, they found the tasks effective in this context. Similarly, another participant mentioned that a free exploration of the BlindDate site with the simulated impairment would have been too open-ended, and therefore they preferred the specific tasks. One participant elaborated that the tasks helped them focus better on the simulation because their thinking was not occupied by navigating the website and making choices. They speculated that otherwise, they might not have read the additional information presented.

Two of the aforementioned participants considered how to implement free exploration without structured tasks in a context beyond the awareness-raising aspect of BlindDate. They suggested that such an approach could allow for a deeper engagement with the topic by experimenting with one's own everyday use cases through the simulations.

Lastly, one participant noted that the tasks had an appropriate level of difficulty and were not too challenging, especially the mathematics problems in the game about Hannah.

Immersion

A qualitative question was asked to determine whether the games effectively allowed players to momentarily "step into the shoes" of the students. All participants confirmed that the games were successful in doing so, with differing reasons.

Four participants explained that personally experiencing the impairments during the games helped them empathize with the personas. When the persona described their experience in a specific situation, the simulation allowed the participants to directly empathize. This experience allowed them to understand aspects of living with a disability that they had not been aware of before. As a result, they were better able to imagine what it means to have a disability, more so than if they had only received a theoretical explanation.

Four participants experienced their most significant moments of understanding through the loss of control. When the game temporarily took away their ability and forced them to guess or struggle with tasks they had previously taken for granted, they found this eye-

opening. Another participant had a similar experience but placed additional emphasis on the emotions they felt during gameplay. They described that they developed the most understanding when they themselves became frustrated by their inability to manage certain tasks. They wanted to perform well in the game but had to realize that it was not possible. This led them to reflect on how this experience mirrors the daily reality of students with disabilities.

One participant noted that they were able to empathize with the personas because the games explicitly communicated that the simulations were not fully realistic representations of the disabilities. This explanation helped them to grasp the broader challenges and strategies involved without it feeling trivialized. However, they felt that this contextualization was lacking for Maxi, leading to a reduced sense of empathy towards this persona.

9.4.6 Behavioral Change

The participants were asked whether they intended to make any changes to their own teaching after playing the games.

Four participants immediately noted that while they were generally inclined to adapt their teaching for students with disabilities, they currently did not see a need for it, as they did not have any students with disabilities in their courses. One participant explained that implementing accessibility measures was too much effort if there was no certainty about its necessity. However, all of these participants expressed their willingness to take action as soon as a student discloses their needs. Additionally, two participants mentioned that they now felt better prepared for such situations, and three indicated that they would make a more explicit effort to communicate that students with disabilities are welcome to approach them.

Two participants expressed a desire to make their teaching more accessible but faced concerns about implementing certain measures. One participant was apprehensive about privacy issues when recording and posting lectures online. Another participant was worried that offering online lectures might reduce student attendance and hinder discussions. However, the latter participant emphatically stated that, despite these concerns, ensuring accessibility for students with disabilities would take precedence over their preferred format for lectures.

One participant decided to add subtitles to their lecture videos in the future. They noted that being able to state that the lecture and materials are accessible also adds value to it, making the additional effort justifiable when explaining it to their superiors.

9.5 Post-Study

Six of the attendees participated in the quantitative survey regarding the existing guidelines. The guideline “strategy-based” received the highest ratings, with two participants strongly

agreeing (6 points) and the remaining four participants agreeing (5 points). The guideline "task-based" garnered full agreement from two participants, agreement from one participant, and slight agreement (4 points) from three participants. The guideline "guided" achieved the most full agreements, with three participants giving it 6 points. Additionally, two participants agreed. One outlier indicated a tendency to disagree by giving it 2 points.

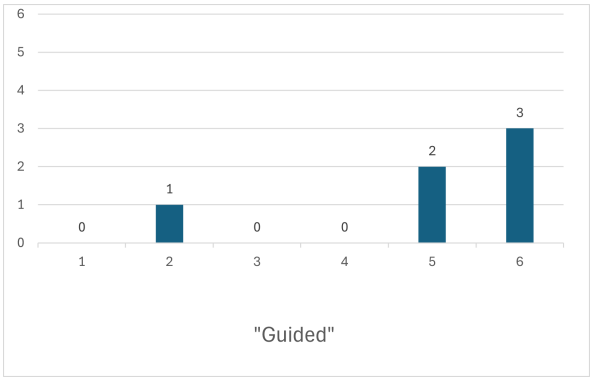


Figure 35: Evaluation of the "Guided" Guideline

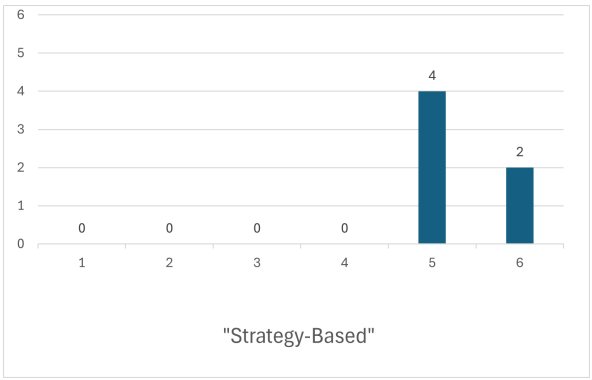


Figure 36: Evaluation of the "Strategy-Based" Guideline

Only one participant responded to the open-ended questions within the survey. As additional guidelines, they suggested including "fun, engagement, [and] problem-solving". Regarding the question of how to improve the evaluation process to achieve better results, they suggested to "think about incidental learning".

Most of the attendees actively participated in the discussion following the author's presentation. The author herself proposed that the short duration of the simulations might be a reason why the games failed to significantly improve players' perceptions of people with disabilities. She suggested that the simulations were too brief, and even though they tried to

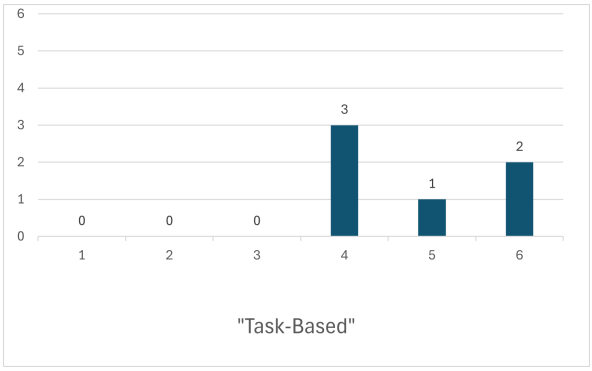


Figure 37: Evaluation of the "Task-Based" Guideline

teach about strategies, participants may not have had enough time to adapt. Two experts expressed their agreement, however, with one participant suggesting that increased empathy should be reassessed in the same participants after a few months. The participant speculated that the learning might need time to settle into the subconscious and that there could have been changes in empathy that were not yet measurable at the time of the initial assessment.

One participant suggested making the games more enjoyable to increase engagement by incorporating themes and worlds that the target audience finds appealing, moving away from the university context of the personas and instead opting for a more abstract approach. They proposed that the games should be designed to be so much fun that players do not even realize they are learning something. They further explained that if the games were engaging enough to induce a flow state, time would no longer be an issue, as players who are immersed in the fun of a game often play for extended periods. Another participant agreed that incorporating more elements of fun into the simulations would be beneficial, but disagreed with the aspect regarding time. They pointed out that the target audience for BlindDate consists of teaching staff who generally have limited time and would not dedicate time to a lengthy game.

The same participant proposed an alternative approach of selecting a familiar context tailored to the respective player, such as their university's website. They suggested that the game should demonstrate strategies, as recommended in the "strategy-based" guideline, to show how a person with disabilities tackles the very same tasks that the player performs daily.

The previous participant only partially agreed with this approach. They pointed out that simulation games can target different points on the learners' curve. If BlindDate aims to raise general awareness about students with disabilities by introducing teaching staff to the topic for the first time, then such specific learnings might not be appropriate at this stage. These detailed learnings would become relevant later on the learning curve.

One participant discouraged guiding the player as suggested by the guideline "guided", arguing that allowing players to navigate on their own enhances their problem-solving skills. However, several other participants from the audience disagreed, asserting that in a context like BlindDate, the guideline is important and necessary.

10 Discussion

10.1 Attractiveness

The assessment of attractiveness yielded generally good results, as indicated by the calculated mean values. However, not all of these outcomes may be fully meaningful, partly due to the small study population and other factors discussed below.

10.1.1 Hannah

The game about Hannah achieved the highest scores across all three categories measured by the UEQ. The qualitative feedback from participants did not offer clear explanations for this outcome. It is important to note that this game had the smallest number of participants, which could mean that the alignment of opinions among this small group had a more pronounced effect on the results. Nonetheless, it is also possible that this game was the most well-designed. Observations suggested that players found this game to be the most intuitive. When a game is easy to navigate, this usability can significantly enhance players' overall impressions.

10.1.2 Gabriel

The game about Gabriel ranked second in two out of the three categories. The category Attractiveness, in particular, is difficult to analyze, as will be further discussed in the context of Maxi's game. However, Gabriel's game clearly outperformed Maxi's in terms of Stimulation, i.e. whether the game is perceived as "valuable", "interesting", and "motivating". It can be hypothesized that this may be because Gabriel's game was better understood by participants than Maxi's. This is supported by verbal comments indicating that Maxi's game was perceived as more abstract and tedious compared to the others. When the conveyed information is more tangible, it might also be perceived as more interesting, as players do not need to exert additional cognitive effort to relate the experience to real-world scenarios. Moreover, the nature of Maxi's invisible and stigmatized impairment may have made it more difficult for participants to identify with the persona and, subsequently, to appreciate the value of the simulation.

10.1.3 Maxi

The game about Maxi excelled in the category of Novelty, outperforming the game about Gabriel. This category assesses whether the game is perceived as "creative" and "innovative". The results align with qualitative feedback in which participants noted that simulations of visual impairments are more commonly encountered, while simulations of mental illnesses are more original. However, there is a slight contradiction, as simulations of hearing impairments were also considered somewhat familiar by some participants. It is important to note that more participants played Maxi's game and completed the corresponding survey than did for the other two games. If few players from both Hannah's and Maxi's games particularly appreciated the respective mechanics, those voices would carry more weight in Hannah's case. Nonetheless, combining quantitative and qualitative insights suggests that Maxi's game was actually perceived as the most novel by the participants.

The items in the category Attractiveness were interpreted very differently across all games. This category includes terms like "enjoyable" and "pleasant". Some participants associated these terms with specific in-game situations that they found unpleasant, such as those that induced feelings of stress. Others referred more broadly to the overall gaming experience, which they found positive because it offered them a shift in perspective. The reason Maxi's game scored the lowest in this category may be attributed to stronger emotional reactions elicited by the first interpretation compared to the other games. This was evident both in qualitative discussions with participants and in observations of their gameplay. Consequently, those who interpreted the questions in this manner rated the game lower, thereby lowering its overall score. Therefore, the Attractiveness score may not accurately reflect the intended measure of this category as defined by the UEQ, particularly in Maxi's case. Instead, the lower score for Maxi's game can be seen as an implicit compliment to the game's immersive quality, as participants experienced genuine emotional reactions.

10.1.4 Variance

The high variance and large confidence intervals observed in the study are largely attributable to the small sample size. However, it is noteworthy that in the categories with high ratings, there was considerable agreement among participants. Conversely, there was less agreement in categories that were rated more poorly. This suggests that the aspects of the games that were well-received genuinely resonated with the target group of educators, and did so consistently, despite significant differences in participants' age, the subject specialization, and other demographic factors.

Summary

Overall, all three games were rated positively in terms of attractiveness. The game about Hannah received the highest ratings, while the game about Maxi was noted for its novelty. The UEQ was effective in measuring Stimulation and Novelty, but the Attractiveness category allowed for too much subjective interpretation. The small study population and the uneven distribution of participants across the games limited the precision of the quantitative analysis.

10.2 Knowledge

The evaluation of the knowledge questions supports the hypothesis that players internalize learning content more effectively when they experience it directly through playable mechanics. This finding underlines the importance of not merely explaining strategies and assistive technologies theoretically through in-game texts, but of further making them playable and experiential. This approach is crucial for ensuring that these strategies, and consequently a more positive perspective on students with impairments, are retained in memory. While the simulated impairments themselves are also more memorable when played, they are often remembered as negative experiences. Understanding how to effectively anchor learnings in players' minds suggests that the strategies for fulfilling the given tasks should also be made experienceable.

Summary

Most, but not all in-game texts were read carefully. However, content that was experienced firsthand proved to be more memorable. This suggests that the principle of experiential learning should be employed for positive rather than negative experiences.

10.3 Empathy

10.3.1 Perception

The analysis of the pre- and post-game perception questionnaires did not reveal the anticipated outcome. Specifically, the expectation that participants would view students with disabilities as more capable after playing the games was not fulfilled. The intention was that by demonstrating the strategies and adaptations employed by these students, participants would recognize their capability in managing their studies more effectively than initially assumed. Given this, the hypothesis shifted towards expecting that if participants' perceptions of the portrayed students became more negative, such changes would primarily occur in the specific areas highlighted within the game.

Hannah

In Hannah's case, this revised expectation was largely confirmed. The most significant negative shift was observed in the category "...follow an online lecture", which directly related to the situation depicted in the game, where participants encountered frustrations due to poor subtitle quality. The second most significant negative shift was observed in the category "...follow an on-site lecture". This shift may be attributed to participants subconsciously transferring their frustrations from the online lectures to in-person lectures, assuming that if Hannah struggled with online audio, she would similarly struggle with in-person audio. They likely did not distinguish that online lectures, despite having poor audio quality, offer subtitles as a strategy, whereas in-person lectures did not have any accommodations discussed in the game. Participants seemed to still be influenced by their immediate negative experiences with the online lecture environment. For instance, one participant remarked that online lectures were more challenging than anticipated due to the poor subtitles, without acknowledging that subtitles were necessary for accessing the lecture content in the first place.

For the categories "...upload a submission to an LMS", "...find their way around the campus", and "...write an academic paper", participants' ratings remained consistent with their initial assessments. One possible explanation is that these categories were not directly related to hearing difficulties. Most participants had already provided high initial ratings of five points in these areas, indicating that they believed Hannah could perform these tasks as well as non-impaired students, and this perception did not change. Additionally, these categories did not directly connect to the game's content, making it difficult for participants to project their experiences with lecture videos onto Hannah's performance in these contexts.

There was one instance of an improved rating for Hannah, specifically in the category "...take an oral exam". Initially, the participant suggested that Hannah might not understand the examiner's questions and that unclear speech like Hannah's would likely be rated negatively. However, the same participant did not provide a rationale for their improved opinion after playing the game. This change could be attributed to a subconscious reassessment of Hannah's capabilities or might simply reflect random variation.

Gabriel

In contrast to the pattern observed with Hannah, where elements depicted in the game were rated more negatively, Gabriel's case did not exhibit the same trend.

Regarding the categories "...take a written exam" and "...upload a submission to an LMS", which showed the second and third most significant negative shifts, a transfer from the gameplay to these contexts is somewhat understandable, given that all three involve

written components. However, the most substantial negative shift occurred in the category "...take an oral exam". It remains unclear how participants transferred insights from the game to an oral exam scenarios, as these were neither featured in the game nor are they directly related to visual impairments. Qualitative statements from the two participants who reduced their scores from 5 points to 2 points in this category provide some insight: One participant initially rated Gabriel's capabilities in oral exams with 5 points, reasoning that they could not identify anything that would pose a particular challenge for Gabriel in an oral exam compared to students without impairments. After playing the game, they provided no explanation for the subsequent reduction to 2 points. Notably, however, this participant assigned 2 points across all categories in the post-play questionnaire, suggesting that they may have stopped considering each scenario independently, instead offering a generally more negative assessment of Gabriel. The second participant also initially rated Gabriel's capabilities in oral exams with 5 points, based on the assumption that examiners would be aware of his impairment and would make accommodations, such as avoiding the use of visual materials that Gabriel would need to explain. After playing the game, they provided no explanation for the reduced score, but may have subconsciously applied different assumptions.

In other categories unrelated to the game content, such as "...find their way around the campus", no significant changes in scores were observed. In the categories "...follow an on-site lecture" and "...follow an online lecture", which closely align with the game content, only minimal negative changes occurred, unlike the pattern observed with Hannah. However, it is important to note that in categories like "...follow an on-site lecture", there was limited potential for further decreases, as the initial scores were already low.

In the category "...write an academic paper", there was an overall improvement, driven by two participants who increased their scores, one of whom raised it by 3 points. Initially, this participant believed that writing a paper would be particularly challenging for Gabriel. After playing the game, they commented that it would be manageable for Gabriel if he could work at his own pace and utilize his assistive device. However, this shift in perception appears less attributable to the game itself and more to the initial persona introduction.

In the post-play questionnaire, one participant was notable for rating Gabriel more positively in three categories ("...follow an on-site lecture", "...follow an online lecture", and "...upload a submission to an LMS"). Initially, when considering "students with visual impairments", this participant seemed to think more of individuals who are completely blind. They observed that online lectures and uploads to an LMS are feasible, albeit slow, on a personal device with a screen reader. After playing the game, they appeared to focus more on Gabriel's specific condition of glaucoma, repeatedly stating that the game had demonstrated how tasks were achievable with this condition. Interestingly, however, this same participant

did not exhibit a similar pattern when assessing the second game about Maxi. In that case, they remained consistent in their scoring before and after gameplay in six out of seven categories and only downgraded their assessment in the one category directly addressed by the game.

Maxi

The survey results for the game about Maxi align with the response patterns observed in Hannah's game, thereby supporting the new hypothesis. Significant negative changes were noted in the category "...follow an on-site lecture", likely because the game vividly depicted the challenges of attending a lecture during a panic attack. Categories like "...find their way around the campus", "...upload a submission to an LMS", and "...write an academic paper", which were not directly related to the game content, saw little to no change in participants' ratings.

Unlike Hannah's game, however, some participants did understand the strategies and accommodations depicted in Maxi's game as helpful, which is reflected in their responses. Although five out of nine participants still rated the relevant scenarios more negatively after playing, likely because the occurrence of a panic attack even at home was also a negative aspect of the game, there were also two positive changes, one of which was notably higher than 5 points. This was the only instance in the entire user test where a participant assessed that a student with a disability could not only handle a situation equally well as a non-disabled student, but better. This participant stated that the online environment was actually better for Maxi than for non-disabled students because, while isolation is a significant challenge for non-disabled students, it provides real support for Maxi.

Nonetheless, Maxi's game showed the most significant negative shift in the total sum of points. A possible explanation is that participants, perhaps due to the stigma surrounding mental health, may have been less familiar with the impact of such conditions and were more surprised by the extent to which the disability affected performance, as depicted in the game.

Summary

The outcomes of the perception questionnaire related to Hannah and Maxi aligned with the newly established hypothesis, showing negative changes primarily in situations directly depicted in the games or in related contexts. In Hannah's game, participants largely perceived the strategies as obstacles rather than helpful. In Maxi's game, few players recognized and rated scenarios higher where the student's strategies could be ideally applied. This pattern, however, was not consistent across all games, as Gabriel's results were less coherent. Some

participants' responses for Gabriel were difficult to interpret, as their altered opinions did not seem to reflect any learnings from the game. The minimal change in perception for scenarios directly addressed in his game may be attributed to study design limitations that could have restricted the measurement of significant shifts in perception.

10.3.2 Willingness

In response to the question of whether students with disabilities should be supported by lecturers, nearly all participants awarded the maximum score. While assigning a score of 7 points can be seen as simply the morally correct choice, this question highlighted an important contrast with the question of whether lecturers are able to support students with disabilities.

Regarding the latter question, many qualitative responses prior to engaging with the simulations expressed concerns, such as lecturers feeling incapable of providing accessibility due to a lack of knowledge, training, or resources. Although the simulations did not completely alleviate these fears, there was a noticeable reduction in general anxiety post-simulation. Concerns became more specific, such as questions about data protection in online lectures, rather than general feelings of being overwhelmed.

Overall, the responses indicated significant positive learning outcomes for the participants. There was only one instance of a quantitative score decreasing, while half of all responses reflected an improvement. Notably, for Gabriel, there were substantial increases in scores, with some rising by up to 3 points on a scale of 7.

There was only one instance of a decreased score for Hannah. However, while choosing this lower score, the participant expressed exclusively positive feedback. This suggests that the change in rating was likely accidental rather than indicative of a negative perception.

Qualitatively, all participants indicated a greater willingness to assist students with disabilities after playing the simulations. Many reported that supporting students was less labor-intensive than they had initially thought. Additionally, there was a new desire to communicate more openly, encouraging students to approach them for support. One participant, in particular, repeatedly emphasized after the simulations that any level of accessibility implementation is better than none and expressed a reduced fear of making mistakes in this area, attributing this shift in perspective to his learnings from the simulations.

Summary

The simulations effectively raised awareness about supporting students with disabilities, as participants expressed a greater willingness to do so. Although initial concerns about lecturers‘ abilities to implement accessibility measures were not entirely resolved, there was a

noticeable reduction in general anxiety. Additionally, participants reported that supporting students with disabilities appeared less daunting than initially expected.

10.4 Post-Survey

During the post-evaluation conducted as part of a workshop, there was generally strong agreement with the guidelines in the quantitative feedback. The only exception was one outlier in the "guided" category, who had already expressed a differing opinion during the discussion. The experts in attendance showed little variation in their opinions, which, considering their expertise, reflects positively on the games. One aspect of the discussion was whether the content of the simulation games should be abstracted by removing them from the context of the personas' university lives. While this approach might work in general, as demonstrated by games like Accessibility Maze, the context is crucial for BlindDate. The target audience of educators should not only enjoy the game but also be able to derive implications for their own teaching. Therefore, this idea was not adopted. For the same reason, namely, that it would not align with BlindDate's goals, the idea from the workshop to apply the simulations to any teaching materials provided by lecturers was also dismissed. Qualitative discussions with participants had already revealed that they did not like this approach, as it would overwhelm them. The approach would further complicate the game design, as it would remove the ability to shape when and what players experience. Without this control, the intended pattern – where, for example, one task is easily solvable while another cannot be solved at all - could no longer be effectively implemented.

Summary

Experts generally agreed with the derived guidelines. Discussions revealed that both abstracting the simulation from the university context or applying it to arbitrary content would not serve BlindDate's goals and hinder the possibility to control player experiences.

10.5 Synopsis

10.5.1 The Good

Several desirable outcomes have been achieved in this work.

The study was successfully executed. The setup was effective, with the survey tool and video conferences functioning well. All questions, including the Likert scales, which were previously unfamiliar to most participants, were well understood. The UEQ proved to be a

suitable instrument for measuring the stimulation and novelty of the games. The participants perceived the duration of the user study as appropriate.

The conveyance of theoretical knowledge was effective. While gameplay mechanics proved to be a more successful medium for knowledge transfer than textual explanations, this outcome aligns with the initial expectations. This allowed for the successful transmission of the intended knowledge in the context of these games.

Participants enjoyed the games and the overall experience. They actively engaged with the games and perceived them as novel and stimulating, as reflected in both the UEQ results and qualitative feedback. There was a strong consensus within the target group on these positive aspects.

The games had their desired impact on a few participants. For instance, after playing, one participant rated the capabilities of the student Gabriel higher in several categories. Another participant rated Maxi's capabilities in online lectures higher than a non-disabled students capabilities in the same situation. One participant frequently emphasized the importance of not fearing accessibility efforts, while several participants expressed that they now understand how even small measures can make a significant difference.

Regarding the educators‘ willingness to support students with disabilities, the results were particularly encouraging. All participants expressed a desire to accommodate students with disabilities more and to communicate their openness on this topic.

Experts in the post-study largely agreed with the guidelines and saw little need for criticism.

10.5.2 The Bad

In some areas, the results were not yet as desirable.

Recruiting participants from a busy target group like educators proved challenging, resulting in a very small study population. Additionally, the participants were not evenly distributed across the games, with the game about Maxi being played twice as often as the others. Although this was intentional, since the games about Gabriel and Hannah are similar and were contrasted with an invisible disability, the uneven distribution complicated the analysis, particularly the quantitative evaluation.

Regarding the study design, the UEQ was not effective in capturing the attractiveness of the games, as the terms in this category were interpreted too variably by the participants. Additionally, the study design sometimes poorly reflected changes in participants' ratings, particularly when initial ratings were low, leaving little room for further change.

One of the main aspects of criticisms from the literature remains unresolved, as the

participants' perceptions of students with disabilities did not appear to improve after playing the games. The goal was to show that by demonstrating the strategies and adaptations used by these students, participants would acknowledge their capabilities. However, participants often focused on the challenges associated with these strategies rather than viewing them as supportive measures.

Maxi's game showed the most significant negative shift in participants' perception of students with disabilities. While this generally aligns with the study's findings, it raises concerns due to the already high levels of stigma associated with mental health issues that should not be reinforced by simulation games.

10.5.3 Areas for Improvement

The study could be revised to determine whether the guidelines and the BlindDate pattern consistently fail to achieve the desired outcomes, or if the current measurements were insufficient to capture these effects. A broader target group and a more balanced distribution of participants across the games being tested would naturally address some of the issues discussed earlier.

A straightforward suggestion emerged from the post-study workshop and proposes to re-evaluate the same participants a few months later, once the game content has potentially been internalized at a subconscious level. This follow-up could either involve the participants from this study or be part of a new long-term study.

In this study, the BlindDate simulations were intentionally tested in isolation to demonstrate the fundamental implementability of the guidelines. However, a comparison between the BlindDate simulations and simulations that do not implement the guidelines might reveal that the latter result in even more negative outcomes. While this would not negate the negative results observed in the current study, it could provide a broader context for evaluating the effectiveness of the guidelines.

Similarly, multiple control groups could be established to play the games under different conditions, such as varying levels of prior knowledge about accessibility. The objective would be to examine whether the impact of the games differs across these groups. For instance, groups could include participants with no prior knowledge, those familiar with BlindDate - representing a realistic user group -, and participants with more prior knowledge gained from courses on accessibility. However, the demographic data from the current study population did not indicate that any of the surveyed variables (e.g. age, gender, teaching subject, prior knowledge) had a significant impact on the outcomes. Thus, it is unclear which specific variable should be the focus of future investigations.

A potential issue in the study is the influence of social desirability, where participants may respond in a way they perceive as morally correct rather than providing their genuine opinions. This tendency could affect both interview responses and Think Aloud protocols, especially since participants were not anonymous in front of the researcher conducting the study. However, it appears that participants were not aware of the desired outcomes of the study, as evidenced by the negative evaluations in their assessments, which suggests some level of honesty in their responses. Nonetheless, increasing the level of anonymity or incorporating more quantitative measures could help mitigate this bias in future research.

10.5.4 Answer to the Research Question

The guidelines presented in this work were developed based on a thorough literature review, applied to three games designed specifically for this study, and subsequently evaluated.

The successful implementation of the three games demonstrates that it is possible to apply all guidelines to simulation games simultaneously. Furthermore, they show that the guidelines are adaptable to different types of disabilities, as they were successfully used to simulate two physical impairments, i.e. hearing and vision, and one psychological invisible impairment.

However, the research question's aim of achieving "exclusively positive effects" through these guidelines was not fully met. While some desired positive outcomes were achieved, they were not universally positive.

The evaluation focused on three pillars: Attractiveness, knowledge, and empathy. Two of these, attractiveness and knowledge, were successfully addressed. Players found the games enjoyable and engaging, and they acquired the intended knowledge. However, empathy yielded mixed results.

While participants demonstrated a strong willingness to support students with disabilities, their perceptions of these students' capabilities, as assessed through the capability questionnaires, did not show the anticipated improvements.

10.6 Limitations

The limitations of this study, including issues related to the sample size, short-term evaluation, and reliance on self-reported data, are discussed in detail in chapter 10.5.3 on potential improvements to the study design.

11 Conclusion

This research aimed to address the criticisms of disability simulations presented in the literature by developing and applying guidelines that ensure these simulations have a positive, rather than negative, impact. The guidelines were derived from a comprehensive review of existing literature and were then implemented in the design of three games, each simulating a different type of disability.

In response to the research questions, the findings indicate that it is feasible to integrate all the guidelines into a single game, as evidenced by the successful design and implementation of the three prototypes. Moreover, the study demonstrates that these guidelines can be effectively applied to various types of impairments, encompassing both physical and mental disabilities, as well as visible and invisible disabilities, specifically focusing on hearing impairment, visual impairment, and mental illness.

The third research question, which concerned the potential for these simulations to generate positive outcomes, was examined through a user study. The study evaluated the games' impact on participants' learning, empathy, and their overall attractiveness. The results show that the learning objectives were successfully met, with gameplay mechanics proving to be a more effective medium for knowledge transfer compared to textual explanations. Additionally, participants reported high levels of engagement, consistently finding the games enjoyable. However, an increase in empathy was observed in only a minority of participants.

Notably, the majority of participants did not perceive students with disabilities as more capable of managing typical academic situations after playing the games. In fact, many perceived them as less capable, reflecting common critiques of traditional disability simulations.

Participants often failed to recognize that the tasks within the games became easier as strategies were introduced, possibly due to the initial shock of experiencing a new disability overshadowing this progression. This may be partly due to the brevity of the simulations, which, while intended to suit the needs of the target audience of university teaching staff, may have limited the effectiveness.

The results from the evaluation across the three measured categories — learning, empathy, and attractiveness — appear somewhat inconsistent. The subjective enthusiasm of the players in the "Attractiveness" category does not align with the unmet objectives in the "Empathy" category.

Future research should consider alternative study designs, as outlined in chapter 10.5.3, to further explore these findings.

References

Bauer, Suse (2020). *"Disability Simulations" – Behinderung als Event oder eine gute Möglichkeit, um auf Barrieren aufmerksam zu machen?* URL: https://raul.de/allgemein/disability-simulations-behinderung-als-event-oder-eine-gute-moeglichkeit-um-auf-barrieren-aufmerksam-zu-machen/.

Bredemeier, M. E. & C. S. Greenblat (1981). "The Educational Effectiveness of Simulation Games: A Synthesis of Findings". In: *Simulation & Games* 12(3), pp. 307–332. DOI: 10.1177/104687818101200304.

Brew-Parrish, Valerie (1997). *Whether their perpetrators realize it or not, Disability Awareness Days send the wrong message.* URL: http://www.raggededgemagazine.com/archive/aware.htm.

Brew-Parrish, Valerie (2004). *The Wrong Message – Still.* URL: http://www.raggededgemagazine.com/focus/wrongmessage04.html.

Burgstahler, Sheryl & Tanis Doe (2004). "Disability-related Simulations: If, When, and How to Use Them in Professional Development". In: *Review of Disability Studies: An International Journal* 1, pp. 4–17. URL: https://www.researchgate.net/publication/245938386_Disability-related_Simulations_If_When_and_How_to_Use_Them_in_Professional_Development.

Chaffin, P.C. & R.A. Peipher (1979). "Simulated hearing loss: an aid to in-service education," in: *American Annals of the Deaf,* 124, pp. 455–471.

Cooper, Alan (1999). "The Inmates are Running the Asylum". In: *Software-Ergonomie '99: Design von Informationswelten.* Ed. by Udo Arend, Edmund Eberleh & Knut Pitschke. Wiesbaden: Vieweg+Teubner Verlag. DOI: 10.1007/978-3-322-99786-9_1. URL: https://doi.org/10.1007/978-3-322-99786-9_1.

Degener, Theresia (2009). "Die UN-Behindertenrechtskonvention als Inklusionsmotor." In: *Recht der Jugend und des Bildungswesens* 57.2, pp. 200–219. ISSN: 0034-1312.

Flower, Ashley, Matthew Burns & Nicole Bottsford-Miller (2007). "Meta-Analysis of Disability Simulation Research". In: *Remedial and Special Education - REM SPEC EDUC* 28, pp. 72–79. DOI: 10.1177/07419325070280020601. URL: https://www.researchgate.net/publication/255552846_Meta-Analysis_of_Disability_Simulation_Research.

French, Sally (1996). "Simulation Exercises in Disability Awareness Training: A Critique". In: vol. 7, pp. 257–266. DOI: 10.1080/02674649266780261. URL: https://www.tandfonline.com/doi/abs/10.1080/02674649266780261.

Gerdes, Karen, Elizabeth Segal & Cynthia Lietz (Oct. 2010). "Conceptualising and Measuring Empathy". In: *British Journal of Social Work - BRIT J SOC WORK* 40. DOI: 10.1093/bjsw/bcq048.

Germany, Federal Republic of (2019). *Hochschulrahmengesetz*. URL: https://www.gesetze-im-internet.de/hrg/BJNR001850976.html.

Hertel, John Paul & Barbara Millis (2002). *Using Simulations to Promote Learning in Higher Education: An Introduction*.

Krauthausen, Raul (2015). *Das „Ein Tag im Rollstuhl"-Problem*. URL: https://raul.de/leben-mit-behinderung/das-ein-tag-im-rollstuhl-problem/.

Krauthausen, Raul (2017). *Warum es nicht ausreicht, Inklusion zu wollen – Von der Bewusstwerdung zur Akzeptanz und Aktion*. URL: https://raul.de/leben-mit-behinderung/warum-es-nicht-ausreicht-inklusion-zu-wollen-von-der-bewusstwerdung-zur-akzeptanz-und-aktion/.

Morris, O. F. (1976). "Simulation of Visual Impairments as a Training Technique". In: *Journal of Visual Impairment & Blindness* 70(10), pp. 417–419.

Nario-Redmond, Michelle, Dobromir Gospodinov & Angela Munoz-Geoghegan (Mar. 2017). "Crip for a Day: The Unintended Negative Consequences of Disability Simulations". In: *Rehabilitation Psychology* 62. DOI: 10.1037/rep0000127.

NDA (2022). *A literature review of methods used to measure attitudes towards disability*.

Piskorek, Patricia et al. (2023). "Re-Conceptualizing Disability Simulations: a guided strategies-based approach". In: *Book of Abstracts*, p. 265.

SHUFFLE (2024). *SHUFFLE Projektwebseite*. URL: https://shuffle-projekt.de/.

Silverman, Arielle, Jason D. Gwinn & Leaf Van Boven (2015). "Stumbling in Their Shoes: Disability Simulations Reduce Judged Capabilities of Disabled People". In: *Social Psychological and Personality Science* 6, pp. 464–471. DOI: 10.1177/1948550614559650. URL: https://journals.sagepub.com/doi/epub/10.1177/1948550614559650.

Silverman, Arielle et al. (Feb. 2017). "Instilling positive beliefs about disabilities: pilot testing a novel experiential learning activity for rehabilitation students". In: *Disability and Rehabilitation* 40, pp. 1–6. DOI: 10.1080/09638288.2017.1292321.

Steinkühler, Julia et al. (2023). *Die Studierendenbefragung in Deutschland: best3*. Report. Deutsches Zentrum für Hochschul- und Wissenschaftsforschung. URL: https://www.studierendenwerke.de/fileadmin/user_upload/beeintraechtigt_studieren_2021.pdf.

UEQ, Team (2024). *User Experience Questionnaire*. URL: https://www.ueq-online.org/.

A Links

A.1 Prototypes

Hannah:

https://www.figma.com/proto/z6llyNndcmbL1Dlvp9FIxn/Patricia-Workspace?node-id=0-1&t=s3Y1kXFCX3OgBZwM-0&scaling=min-zoom&content-scaling=fixed&starting-point-node-id=126%3A779&show-proto-sidebar=1

Gabriel:

https://www.figma.com/proto/z6llyNndcmbL1Dlvp9FIxn/Patricia-Workspace?node-id=0-1&t=s3Y1kXFCX3OgBZwM-0&scaling=min-zoom&content-scaling=fixed&starting-point-node-id=126%3A755&show-proto-sidebar=1

Maxi:

https://www.figma.com/proto/GXXT54iHzDtl9qh2YgE9Gd/PP-MA?node-id=0-1&t=kxWla76fL87DnidO-0&scaling=min-zoom&content-scaling=fixed&starting-point-node-id=17%3A1986

A.2 Games

Hannah:

https://shuffle-project.github.io/blinddate/iframe/hannah/

Gabriel:

https://shuffle-project.github.io/blinddate/iframe/gabriel/

Maxi:

https://patriciapiskorek.github.io/simgame-maxi/

B Data

The raw data from the user-study is available in digital form and can be accessed upon request. Please contact the author of this thesis for further information.

The raw data from the post-study is available in digital form and can be accessed upon request. Please contact the author of this thesis for further information.

C Protocols

C.1 Workshop with Students

Survey:

A group of 15 students were asked about their experiences with disability simulations:

- Have you ever participated in disability simulations?
- In what context?
- What did you think was good or bad?

Answers:

- during the driving test; glasses that simulate being drunk; 'funny'
- at a vocational school; wheelchair course organised by physically disabled people; pushed from behind when problems arose; 'they have a hard time'
- in the course of their studies; sport with fatsuit, blindfold glasses, gloves, breathing through a straw; 'it was interesting'; 'i realized how well I am doing without impairments'
- at a holiday camp; guided through the grounds with a blindfold, e.g. through a stream; 'i needed a lot of trust'
- after breaking a bone; plaster cast; 'luckily it was only for a few weeks'

Group work:

Choose one of our BlindDate personas:
Visual Impairment — Hearing Impairment — Mobility Impairment — Chronic Illness — Mental Illness — Learning Disability — Neurodivergence — Care Responsibilities

- How could this impairment be simulated? (Idea)
- What could be the purpose of simulating this impairment? (Purpose)
- What positive effects can this have on players? (Advantages)
- What negative effects can this have on the end of the game? (Disadvantages)
- Which aspect of this impairment cannot be simulated? (Limits)

Answers:

- idea about hearing; easiest to simulate; with noise cancelling headphones or playing sounds like tinnitus; the aim is to give an impression that it is exhausting to live with

an impairment; to better empathise with the participants; after the simulation, participants understand what hearing-impaired people need when interacting with them.

- idea on neurodiversity; lowering the filter of the brain is not possible, therefore artificially increasing the stimuli; experiencing 'what it does to the players' to live with overload; perhaps players will find strategies in the course of the situation, to deal with the impairment.

C.2 Workshop with Experts

(the author herself) assumed that her simulations were too short, even though they tried to teach about strategies, participants could not adapt quickly enough.

(participant 1) agreed.

(participant 2) agreed.

(participant 2) suggested having another interview after a few months time when the empathy has settled into subconsciousness, as maybe there were improvements we just couldn't measure yet.

(participant 3) proposed to make the games more fun, so people want to engage and do not realize they're learning something.

(participant 2) agreed, stating that then time would not be an issue anymore, as a game can be endlessly long if the player is in a flow state.

(participant 2) disagreed for the given context of blinddate, stating that the target group of teaching staff has little time.

(participant 2) suggested showing strategies to the participants as the guideline suggests, but in a context they know, e.g. their own university's website, to see how someone with a disability does the teachers' daily tasks differently.

(participant 3) disagreed partly and mentioned that this specific learning comes much later in the learning curve than "awareness", i.e. getting in touch with the topic for the first time.

(participant 3) discourages to guide the player as the guideline suggests, as being on their own fosters the players' problem solving.

(participants from the audience) disagreed for the context of blinddate.

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