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ORIGINAL RESEARCH PAPER

Perception and reaction of undergraduate critical disability studies students to six short films depicting neuro-advancements

Chiara Salvatore · Sehar Sami · Sandra Youssef · Markus Schmidt · Gregor Wolbring

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Abstract Advancements in neurosciences and neurotechnologies pose various ethical and social challenges, warranting public/stakeholder engagement. Art, such as short films, can expose audiences to the social aspects of neuro-advancements. The 2019 BIO·FICTION Film Festival, for instance, examined how neurotechnologies shape society, the human body, and mind. Students are one important group of stakeholders, as they are expected to be critical thinkers and change agents. The lived reality of disabled people is impacted by neuro-advancements in many ways. Critical disability studies students are therefore key stakeholders, as their programs and courses encourage them to identify and address social challenges faced by disabled individuals. Therefore, they need to be able to evaluate the social impacts of neuro-advancements. Few studies exist that ascertain the views of critical disability studies students on the social impact of neuro-advancements. Our study sought to amplify the voices of critical disability studies students by analyzing the responses of 89 undergraduates from three courses to six top films from the BIO·FICTION festival. Conducted asynchronously due to COVID restrictions, students watched the films independently and responded to four guiding questions about: a) general thoughts about the films, b) their perceived impact on those watching, c) implications for their anticipated careers involving disabled people, and d) the social impact of neuro-advancements on disabled people. Our findings indicated that the topical (non-)fictional short films effectively prompted students to reflect on the social aspects of neuro-advancements and were well received. However, responses also indicated a need for follow-up discussions – virtual or in-person – to address questions about film content and deepen the discussion and class engagement. Such discussion setups could also inform film festivals aiming to raise awareness about the societal implications of emerging technologies.

Keywords Neuro-art · Arts · Stakeholder Engagement · Students · Neurogovernance · Disabled People · People with Disabilities · Critical Disability Studies · Disability Studies · Neuroethics

C. Salvatore · S. Sami
Cumming School of Medicine, University of Calgary, 3330 Hospital Drive NW, Calgary, AB T2N4N1, Canada

S. Youssef · M. Schmidt
BIOFACTION, Vienna, Austria

G. Wolbring (✉)
Department of Community Health Sciences, Specialization Community Rehabilitation and Disability Studies, Cumming School of Medicine, University of Calgary, 3280 Hospital Drive NW, Calgary, AB 3D10T2N 4Z6, Canada
e-mail: gwolbrin@ucalgary.ca

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Background

Neuro-advancements are leading to more and more products that can be used by medical professionals. At the same time many of these products are also used outside of the medical arena such as the workplace [1] (see for example the emergence of the field of neuroergonomics [2, 3]) and are also used in neurohacking (Do it yourself DIY neuro) [4]. Many ethical and social issues are discussed as potential consequences of neuro-advancements in the neuro-academic literature [5–9] including neurohacking [10–12] and neuroethics is discussed in conjunction with other fields such as AI-ethics [13–16]. Public/stakeholder engagement is an important aspect of science and technology research and development, including neuroethics and neurogovernance discussions, where the goal is to increase knowledge on the issues neuro-advancements pose [9, 17–21]. This is ever more important the more neuroproducts become available to the general public.

Students are one important stakeholder group, as they are envisioned to be critical thinkers, change agents [22–28] and active citizens [29–39]. Many educational efforts positioned at the intersection between science and/or technology and society [40] aim to instill into students an appreciation for the societal impact of scientific and technological change [41] and for students to be socio-scientifically literate [42–45].

Disabled people often serve as targets for the development of neuro-advancements but many problems with neuro-advancements have been flagged over the years [46–58]. Neurohacking is also discussed in relation to disabled people [4, 59]. Critical disability studies focuses on the lived reality of disabled people [60, 61] and is based in social justice for disabled people [62] and disability justice [63–67]. Terms such as neurotypicality, neurodiversity, and neurodivergence are dominantly used in critical disability studies; for example, the medical view linked to autism is questioned in critical disability studies [68–75]. Critical disability studies students engage with the social problems disabled people face in order to make a positive difference in the lives of disabled people [76]. Disability studies students see themselves as allies of disabled people [63] and raise awareness about the problematic lived reality of disabled people [77]. But in order to be an ally and to raise awareness, one needs to be literate on the lived reality of disabled people [78]. That literacy must include the understanding of the impact of science and technology advancements, including neuro-advancements, on the lived reality of disabled people. However, searching the academic databases Scopus, Web of Science, and the 70 databases of EBSCOHOST, we found only one [59] article that covered views of "disability studies students" on some aspects of neuro-advancements.

Art and artists have a long history of providing social commentaries using art as a medium [79–86], including in relation to science and technology in general and neuro-advancements specifically [87–93]. Art, such as films, can influence people's knowledge and views of a given subject and trigger engagement with a given topic [94–99]. Art is used to educate on science and technology in many settings, such as higher education [100–113] and museums [114–123], and is used in professional development and lifelong learning initiatives [124–134]. An example of this is the 2019 BIO·FICTION Science Art Film festival, which examined the societal impacts of neurotechnology within the context of the project "FUTUREBODY: The Future of the Body in the Light of Neurotechnology" [92] that dealt with the future of the human body against th backdrop of neurotechnological progress . Given the underappreciation of the views of disability studies students on neuro-advancements and the potential important role disability studies students can play in these discussions, the purpose of our study was to engage 89 disability studies students in a critical reflection on the potential consequences of neuro-advancements. We aimed to investigate whether the six top films of the 2019 BIO·FICTION film festival [135] triggered students to think about social aspects of neuro-advancement. This critical reflection was submitted online as a marked assignment, with no live component. For each film, students were asked four questions. (1) "What are your thoughts on the given film in general?" The first question was asked to get a general sense of the views the film triggered in the students. The second question was (2) "Do you think the given film has an impact on people watching it? If yes, what impact? If not, why not?" We asked the second question because how we deal with neuro-advancements depends in part on how people see the topic. How

people view or interpret the six films also impacts how they engage with the social aspects of neuro-advancements. Finally, the lived social reality of disabled people is often impacted by how others perceive disabled people, and what they see as take-home messages of the films. How spectators react to the films might also impact how they see the influence of neuroenhancements on the lived reality of disabled people. Disability studies students enter many different occupations affected by how neuro-advancements impact the social reality of disabled people, such as being academics, health professionals, policy makers, or working in community service and disability advocacy organizations. Therefore, we asked (3) "What are your thoughts about the given film thinking about your profession you want to go into?" Disabled people are one group impacted by neuro-advancements; disability studies students frequently engage with the lived reality of disabled peoples and aim to make a positive difference in the lives of disabled people [76]. Therefore, we asked (4) "What are your thoughts about the given film's impact on disabled people".

We propose that our study is of interest to disability studies scholars but also various education fields such as intersectionality pedagogy, citizenship education, arts education, and various science and society education areas. The data might also be of interest to anyone involved at the intersection of disability and science and technology governance.

Disabled People and Neuro-Advancements

Neurotechnology/neuro-advancements are often discussed as benefiting disabled people by providing them with specific advantages. However, at the same time, many problems related to neuro-advancements are noted for disabled people, including how disabled people are portrayed and engaged with in neuro-related discussions [46–58] including the aspect of intersectionality [59, 136, 137] and hacking [59]. "Neurotechnologies under development are often explicitly justified in terms of the advantages they will provide to disabled people", and therefore "it would seem important to know what disabled people want from current and future iterations of these technologies and how they experience the functional barriers the technologies are meant to address" ([57], p. 615). Art performed by disabled artists or disability arts [88] could be used to engage disabled people and others with the topic of neuro-advancements and to make visible the impact of neuro-advancements on disabled people. It could also be used to raise awareness about the impacts of neuro- and other scientific and technological advancements on disabled people.

Critical Disability Studies and Neuro-advancements

Disability studies courses are based on furthering social justice for disabled people [62], questioning the narrative around the normative body [138]. Critical disability studies ought to disrupt traditional research boundaries [69] and enhance the lived reality of disabled people in all their facets [139]. Concepts used in critical disability studies include "critical access", "disability justice", crip time and crip knower-makers [68]. Critical disability studies is often covered in relation to autism, with the terms neurotypicality and neurodiversity questioning the medical view linked to autism [68–75]. It also often covers the intersectionality of autistic/neurodivergent people with other marginalized identities [74, 140]. Disability studies is also linked to critical autism studies [70] and critical pedagogy [71, 141], with critical disability studies providing tools for anti-ableist pedagogy, which is expected "to promote the inclusion and belonging of disabled students, and to challenge the exclusion of disabled students" ([141], p. 1).

Disability studies is teamed up with critical pedagogy for health professional education [142]. One study suggests that neurorehabilitative research should be informed by insights from critical disability studies, proposing that principles of crip technoscience and critical disability studies perspectives should be included in neurorehabilitation education [143]. Reflecting on the use of playwriting assignments in a critical disability studies classroom, one study concluded that "the use of art-based approaches in teaching critical disability studies can provide students with the opportunity and space to take creative risks and advance their critical thinking skills in ways that go beyond the traditional assignment" ([144], p. 137). In another study, it is concluded that "after exposure to critical disability studies, students were

more willing to discuss other social justice issues relating to race, sexuality, religion, and class" ([145], p. 1).

Disability studies students often go into allied health professions, but it is noted that their view of how these fields ought to engage with disabled people is influenced by their background in disability studies. For example, a critical disability studies lens demands that occupational therapy engages with disabled people different than what often is put forward [146–155]; for disability studies meeting other health professions such as social work and speech language pathology see [156–161]. The premises of disability studies and the positionality and goals of disability studies students suggest that students should be exposed to and become socio-literate about scientific and technological advancements, including neuro-advancements, as these advancements impact the lived reality of disabled people.

Role of Art

Art and artists play a significant role in society [79, 80], such as being educators [162]. An essential aspect of this role is that they use art to communicate the unresolved issues of society, in turn raising awareness [81]. Art and artists play a vital position in maintaining social responsibility [82], creating social justice [83], activism [84, 163], advocacy [85], critiquing and exposing stereotypes embedded in society [86], promoting citizenship [98], and a culture of rights [98]. Art projects may also have emotional and ideological impacts [164–177]. Some artists create art to depict the dynamics of society, narrating future events and movements based on reflections of the past and present society to [178]. Many artists feel a sense of obligation when it comes to their art to uphold a social responsibility [82]. This intrinsic ethical responsibility of art is a form of expression for an artist to demonstrate the issues seen (or not seen) in the world today [82]. Art can also be used as a means for expressing knowledge [179] and as a tool to help one gain awareness of social issues [180]. There is a significant need to raise political awareness and foster social responsibility that artists should express through the use of the art they create [88, 163]. For example, as "disabled people are the experts of their current social situation, disabled artists can also bring specific knowledge linked to their lived experience" into art, thus allowing them to use art to communicate specific issues relevant to them ([88], p. 104). For many disabled artists, their art is a form of self-advocacy that enables them to voice their opinions to impact change [181]. However, the literature suggests that many problems exist for disabled artists, as they struggle to serve as change agents and impact society [88, 182].

Films, including short films, are one form of art that can impact people's knowledge and views of a given topic, including human rights; films may transform society, serve as pedagogical tools, generate critical thinking, and create a climate for discussions [94–99]. Film festivals play a major role in the impact of films [183–187]. Activist film festivals, which focus on social change, are said to potentially reinvent viewers as responsible citizens [188]. For example, the Women's Film Festival in Taiwan was noted to have positively contributed to the Taiwanese women's rights movement [189] or disability film festivals, which may help create new understandings of disability [190–194]. During the COVID-19 pandemic, it has been noted that many film festivals have shifted online, in turn experiencing unprecedented high attendance levels and increased reach and accessibility as attendees did not have to travel to specific locations [195].

Role of Art in Relation to Science and Technology, Including Science and Technology Education

Art has a long history in relation to science and technology [87, 88], including neuroscience, known as neuroart [89–93]. It has been noted that art is often used to express scientific thought [87]. Films, in particular those targeted at a mass audience, are themselves a source of information about how science and technology are seen by the filmmakers and presumably by the audience [196, 197]. Art about emerging technologies and their societal ramifications may also help to reveal what is important to the public.

Surrounding the role of arts concerning science and technology, it is noted that:

- "Art is a unique and powerful communicator that engages people in a different way than graphs and

data do. This can change participants' perception of a scientific concept.
- Art engages people emotionally and can create strong feelings towards science, which can increase engagement and retention.
- Art is intrinsically cultural and can strongly influence bonding around environmental issues, connecting people to each other and to the issue.
- Art is an effective marketing tool for science organizations because it increases positive perceptions and engages new audiences" ([121], p. 3).

Many academic educational efforts are positioned at the intersection of science and/or technology and society [42, 198–221], and art has been incorporated into STEM (science, technology, engineering, and mathematics) education, resulting in STEAM (science, technology, engineering, arts and mathematics) [100–113]. Films are seen as useful tools in teaching STEM, including STEM and society issues [222–225], and the social aspects of science [226]. Social justice is one focus of arts education [227], with there being a linkage between art education, the 'social', and science and technology [228]. Artists are involved in science and technology education and governance discussions in many places [229–256], such as museums engaged with science and technology where they may serve as educators surrounding the intersection of science and society [88, 114–123, 257]. The 2019 BIO·FICTION Science Art Film Festival invited filmmakers from all backgrounds to submit their work to cover a broad and diverse take on how neurotechnology may impact society and our lives. Submissions to the festival were predominantly short films that raised questions about how such technologies could be used to create either a flourishing or a dystopian society [258]. "What the Austrian writer Robert Musil (1880–1942) has described as a sense of reality and a sense of possibility can be encountered in the contemporary debate about" neurotechnology and BIO·FICTION can be seen as a tool for such a debate [258]. We do, however, want to point out that a utilitarian view on the role of art, e.g. as a communicator or marketing tool, can be problematic. The relationship between art and science is not one where the arts is meant to serve science (or the other way round) but to interact on the same level without one being the instrument of the other [259].

Occupations and Neuro-Advancements

Occupations are "everyday activities that people do as individuals, in families, and with communities to occupy time and bring meaning and purpose to life. Occupations include things people need to, want to and are expected to do" [260]. Many different occupational activities can be seen to be impacted by neuro-advancements. Disability studies students engage in many occupation-related activities that intersect with disabled people, such as being allies to disabled people in their private lives and in their future employment [63], raising awareness about the problematic lived reality of disabled people [77], being educators, being policymakers, working in disability service organizations, disability advocacy organizations and in allied health professions. As disabled people are a main target of and potentially impacted in many ways by neuro-advancements [46–59], and given the goal of disability studies students to make a positive difference in the lives of disabled people, disability studies students have to be socio-scientifically literate on neuro-advancements in all these occupational activities.

To give the example of the allied health profession; there are many roles expected from health professionals that demand an engagement with the impact of neuro-advancements. For example, speech-language pathologists are expected to serve not only as clinical service providers but also to act as advocates for their field and their clients, and to take on roles as educators and researchers [261]. Nurses are expected to provide clinical care, apply evidence-informed literature, participate in research, advocate for their clients and their field, be team players, and be involved in political processes [262–266]. Social workers' roles include serving as advocates on an individual and systemic level, being researchers, educating students and community groups, and continuously learning [267]. The roles of occupational therapists include being an expert in enabling occupation and acting as communicators, collaborators, practice managers, change agents, and scholarly practitioners/professionals [268]. These various professionals, as well as other health professionals, should also fulfil these roles in relation to neurotechnologies [261–264, 267–273]. However, an article by Bell, Legar, Sankar, and Racine indicated gaps within the current training and knowledge of health professionals,

including nurses, in relation to neuro-advancements, stating:

> "Trainees from diverse healthcare professions (e.g., nursing, social work, physiotherapy) are not well prepared to handle many of the ethical issues associated with psychiatric DBS [deep brain stimulation] because, among other reasons, they may be unprepared to engage in ethical reflection, they have a limited understanding of issues associated with scientific uncertainty, and they may lack an interdisciplinary understanding about ethical issues" ([274], p. 6).

Lifelong learning [275–279] is an important aspect for health professionals such as nurses [263, 264, 280, 281], social workers [282–284], speech language pathologists [261, 285, 286] and occupational therapists [287, 288]. Lifelong learning is also seen as important for being active citizens [275, 289–294] and policymakers [295]. It is argued that health professionals should fulfill their role as advocates and being active citizens by using lifelong learning mechanisms [269]. Lifelong learning is also expected from authentic allies of disabled people [78], as one cannot be an ally when one lacks needed knowledge.

Art, such as films, could be one tool to be incorporated into degrees and lifelong learning endeavors for members of many occupations to learn about and engage with scientific and technological advancement, including neuroscientific and neurotechnological advancements. This tool may aid members of many different occupations to have increased knowledge and understanding about and to reflect on the impacts of neuro-advancements, such as the social and ethical issues stemming from these developments. This tool also might be useful for students that want to go into policy work as neuro-advancements pose questions for policymakers [296, 297] and also for community service organizations given the many potential impacts of different neuro-advancements on the lived reality of disabled people and the public at large.

Method

Material

The BIO·FICTION short film festival invites filmmakers from all backgrounds to submit their work covering a broad and diverse take on the impact of science and technology [298]. The 2019 BIO-FICTION festival had as theme the future of the human body and focused on neurotechnologies and how they shape the future of the human body, mind, intelligence, and society [92]. The objective of this study was to examine the perceptions and views of undergraduate students on films from the 2019 BIO-FICTION festival. To achieve the objective of this study, we made use of the six top films [135] of the 2019 BIO·FICTION film festival that took place on September 23rd and 24th of 2019. "We were given private links to each of the six films on the Vimeo platform to give to our students. The descriptions of the films are on the festival webpage but most of the films are not publicly available (unless individual film makers publish them via other channels)."

The films were:

Documentary Winner:*Paramusical Ensemble* (by Tim Grabham / 09:20 / UK 2015).

> The documentary follows the Paramusical Ensemble, which consists of four severely motor-impaired patients and a string quartet, preparing and performing a live musical piece with the help of a Brain-Computer Music Interfacing system [299].

Fiction Winner:*The Auxiliary* (by Frédéric Plasman / 08:42 / Belgium 2018).

> Alone in front of her reflection in a collapsing world, someone desperate, feeling unfairly discredited, is going to end it all. But who is she and why is she doing this? [300]

Jury Special Prize Winner:*Reboot* (by Andrei Thutat Ungur / 14:58 / Romania 2019).

> Reboot tells the story of a lonesome man suffering from depression and obsessive regrets about the past. He chooses to erase his memory in order to restart his life and get a second chance at living a "normal" life [301].

Documentary Runner-Up:*Carlotta's Face* (by Valentin Riedl & Frédéric Schuld / 05:00 / Germany 2018).

> Carlotta is face blind and never recognized a single face - not even her own. Through art, she discovers a creative way to map her face [302].

Fiction Runner-Up:*Perfectly Natural* (by Victor Alonso-Berbel / 13:44 / Japan 2014).

> For Wanda and Zach, Future Families is a lifetime opportunity: a virtual parenting system that gives their baby access to a better life. But they soon realize this technology may come at a higher cost [303].

Jury Special Prize Runner-Up:*Adam & Eve Mk II* (by Sebastian Kuder / 04:13 / UK 2019).

> In a post-apocalyptic future, human memories from the now-extinct species *Homo sapiens* are loaded into the artificial brain of a robot [304].

Participants and analytical lens

Participants for this study were from three senior-level undergraduate classes in one critical disability studies program, which took place between September 2020 and April 2021. Watching the film and answering the questions were one marked assignment in the class. As such, the design of the questions and the deliverable was tailored for the purpose of the courses, and that the courses were taught asynchronously with no live interaction between students and the instructor. It was decided to give these classes asynchronously to give students more flexibility in their daily lives during the COVID pandemic. A link to the films and the questions were provided through the online course platform. In accordance with the ethics approval stipulations, students saw this as a normal course assignment during the time they had to do the assignment. After the final marks were given by the instructor and approved for a given course, the students were asked by email whether they would agree that the data be used without attributing the data to any person for a potential publication. The course assignment content of any student that did not agree was removed by the instructor before the analysis.

We decided to focus on students because students are seen to have many roles that suggest the need for students to know about, be able to evaluate, and be able to contribute to public discussions [305–307] of scientific and technological advancements. Students are described as "revolutionary and transformative figure[s]" ([308], p. 261), serving as change agents [26, 309–311], including in relation to technologies [312]. Students are seen as change agents in the community [313], alongside community stakeholders [24], and in higher education [25, 314, 315]. Active citizenship education in higher education is about enabling students to be change agents [29, 316–319], and the role of being active citizens suggests that students can also involve themselves in science and technology governance discussions [317]. Being a change agent is also linked to the expectation that students have a social responsibility [320]. A "bottom up empowerment of 'students as change agents'" ([321], p. 105) is seen as necessary, as is to train students as change agents [322]. Gaining awareness of a topic, making sense of a given topic and reality, and developing one's own view on a topic is essential for being a change agent [323, 324]. Social responsibility in students is linked to academic achievement [325], higher self-esteem [325], and transnational citizenship [326]. Sensemaking, "the process by which new meaning is created to rationalise the actions of individuals in relation to change" ([327], p. 1047), influences the activity of change agents by helping identify what should be changed but also influencing the very understanding of the role of change agent [327].

We decided to focus in particular on critical disability studies students because disabled people are a main target of and are potentially impacted in many ways by neuro-advancements [46–59].

As critical disability studies students 1) engage with the social problems disabled people face in order to make a positive difference in the lives of disabled people [76], 2) see themselves as allies of disabled people [63], 3) want to raise awareness about the problematic lived reality of disabled people [77], and 4) very likely encounter neuro-advancements in many of their occupational activities linked to disabled people, it is evidently important for the students to understand the views of critical disability studies on neuro-advancements,to find ways to increase their socio-scientific literacy on neuro-advancements, and for them to in neuro-governance discussions. We used the six short films to achieve these goals. Given that participants were critical disability studies students, we used as an analytical lens the premise of the field of critical disability studies and the motivation students have to join a critical disability studies degree or course.

Questions and Data Collection

The study received ethics approval from the institutional review board. After the ethics approval, the students were sent a link to the top six films and asked to answer the following four questions for each film:

(1) What are your thoughts on the given film in general?
(2) Do you think the given film has an impact on people watching it? If yes, what impact? If not, why not?
(3) What are your thoughts about the given film, thinking about your profession you want to go into?
(4) What are your thoughts about the given film's impact on disabled people?

Questions 1 and 2 allowed us to obtain an insight into the general thoughts students had in relation to the films. Question 1 allows us to obtain a general sense of the usefulness of any of the six films for our objective to understand the views of our participants on neuro-advancement, to increase participants socio-scientific literacy on neuro-advancements, and to engage them in neuro-governance discussions.

We asked the second question because the lived social reality of disabled people is often impacted by how others perceive disabled people, which in turn impacts the role of students as change agents but also the reality they might encounter in their future engagement with disabled people. The films might directly impact the perceptions viewers of the films have of disabled people. Indirectly, the lived reality of disabled people might be impacted by the perception and views people develop after they watched the films.

Question 3 was asked because neuro-advancements might influence many of the occupational activities participants might engage in in relation to disabled people at the present time and after graduation. Furthermore, what our participants do now and in the future in relation to neuro-advancement could have an impact on disabled people.

Question 4 was asked because disability studies students want to make a positive difference in the lives of disabled people and see themselves as allies of disabled people. As such, it is important to understand the views of students on the consequences of neuro-advancement for disabled people because that view will influence how they engage with neuro-advancements in their self-understanding of wanting to make a difference in the lives of disabled people.

Data Analysis

Student responses (one PDF per class) were downloaded with names removed from the answers. The three PDFs were uploaded into ATLAS.ti 9™, a qualitative data analysis software. We performed a directed thematic analysis [328, 329] following the six-phase thematic analysis process outlined by Braun and Clarke [329]. Differences in codes and theme suggestions of the qualitative data were few and discussed between three of the authors and revised as needed to ensure credibility and dependability. Confirmability is also evident in the audit trail made possible by using the Memo and coding functions within ATLAS.Ti 9™.

Results

This section has two parts to give an overview of the data we found. The first part compared the views students had about all films on some key themes linked to the four questions (Tables 1, 2, 3 and 4). In the second part, the top three themes evident in the student responses to each film are presented (Tables 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15 and 16). All numbers are numbers of respondents. A detailed list of all themes, along with the number of students who expressed a given theme, is provided in the appendix (Tables 17-40).

Part 1: Comparing The Views Of Students On All Films In Relation To Key Themes Linked To The Four Questions

Question 1 Sample Responses: Full Set of Themes and Subthemes the Appendix, Tables 17-40

For question 1 concerning students' thoughts on the given film in general, students most often mentioned aspects of the film they liked/disliked/did not understand, their opinions towards the film's neurotechnology and its consequences, and that the film helped

Table 1 General thoughts on all films

Themes	Subthemes	Films					
		Paramusical Ensemble	*Carlotta's Face*	*Perfectly Natural*	*Adam & Eve MkII*	*Reboot*	*The Auxiliary*
General Sentiments	**Liked by students**	65	38	11	10	10	4
	Disliked by students	2	0	4	13	18	2
	Students did not understand films	0	10	4	19	16	7
Opinions Toward Films neurotechnology	**Students discussed technology consequences**	0	0	44	17	10	10
	Perceived as negative	0	0	19	3	0	2
	Perceived as risky	0	0	4	0	3	0
	Technology as positive	16	0	7	0	0	0
Helps people consider/demonstrates certain concepts	**-**	20	27	23	15	14	0

Table 2 Perceived impacts of all films

Film Title and # of Responses	Unspecified Impact (not stated whether positive or negative)	Positive Impact	Negative Impact	Both Positive and Negative Impact	No Impact
Perfectly Natural (89)	80	0	4	3	0
Carlotta's Face (85)	74	9	0	0	0
Adam & Eve MkII (87)	72	3	0	4	7
Reboot (87)	70	4	5	4	4
Paramusical Ensemble (86)	46	39	0	0	0
The Auxiliary (30)	30	0	0	0	0

Table 3 Professional impact of all films

Film Title and # of Responses	Top 3 Main Themes		
	Film Evoked Sentiments of Professional Responsibility	**Films neurotechnology May Impact Future Work**	**Opinions Toward Films neurotechnology**
Carlotta's Face (84)	72	0	-
Reboot (82)	64	5	-
Perfectly Natural (87)	45	23	8 technology negative, 8 technology positive
Adam & Eve MkII (84)	33	31	11 students noting films neurotechnology consequences, 8 positive
Paramusical Ensemble (84)	34	12	25 positive
The Auxiliary (30)	18	6	-

them consider certain concepts or demonstrated certain concepts.

Students most often stated they liked the film or aspects of the film *Paramusical Ensemble* (65), followed by Carlotta's *Face* (38), *Perfectly Natural* (11), *Adam & Eve MkII* (10), *Reboot* (10), and *The Auxiliary* (4). In contrast, 18 students disliked the film or aspects of the film *Reboot,* followed by

Table 4 Perceived impacts of all films on disabled people

Film Title and # of Responses	Unspecified Impact (not stated whether positive or negative	Positive Impact	Negative Impact	Both Positive and Negative
Reboot (84)	70	4	12	11
Carlotta's Face (83)	59	23	0	0
Adam & Eve MkII (85)	57	11	6	8
Perfectly Natural (86)	46	8	14	0
Paramusical Ensemble (87)	37	46	0	4
The Auxiliary (30)	22	3	6	0

Table 5 The top three themes per each question for *Perfectly Natural*

	Question 1 (87 responses)	**Question 2** (89 responses)	**Question 3** (88 responses)	**Question 4** (86 responses)
Top three themes	Perceived consequences of the films neurotechnology (44)	Helps people consider/ demonstrates certain concepts (48)	Film made students feel a professional responsibility to a certain task/ action (45)	Described consequences of the films neurotechnology (36)
	Helps people consider/ demonstrates certain concepts (23)	Described consequences of the films neurotechnology (42)	Films neurotechnology may impact future work (23)	Technology could be used to care for/improve the lives of disabled people (25)
	Students saw film aspects as possible future (20)	Students saw film aspects as possible future (14)	Described consequences of the films neurotechnology (11)	Demonstrates influence of social norms (10)

Table 6 Proposed impacts of *Perfectly Natural*

	Question 2 (89 responses)	**Question 4** (86 responses)
Proposed impacts of film	Unspecified **(not stated whether positive or negative** (80)	Unspecified **(not stated whether positive or negative** (46)
	Negative (4)	Positive and negative impact (17)
	Positive and negative impact (3)	Negative impact (14)
	-	Positive (8)

Adam & Eve MkII (13), *Perfectly Natural* (4), *Paramusical Ensemble* (2), and *The Auxiliary* (2). Surrounding understanding, 19 students stated they did not understand the film *Adam & Eve MkII*, followed by *Reboot* (16), Carlotta's *Face* (10), *The Auxiliary* (7), and *Perfectly Natural* (4).

Regarding students' opinions of the technology shown in the film, students most often perceived the technology in the film *Perfectly Natural* as negative (19), followed by *Adam & Eve MkII* (3), and *The Auxiliary* (2).

In *Perfectly Natural* and *Reboot,* the films' neurotechnologies were not seen as negative but as risky by 4 and 3 students, respectively. *Paramusical Ensemble* most often led to students stating the technology in the film was positive (16), followed by *Perfectly Natural* (7). Concerning students discussing the consequences of said technology, *Perfectly Natural* led to students discussing the consequences of the film's neurotechnology the most (44), followed by *Adam & Eve MkII* (17), *Reboot* (10), and *The Auxiliary* (10).

Table 7 The top three themes per each question for *Adam & Eve MkII*

	Question 1 (84 responses)	**Question 2** (87 responses)	**Question 3** (84 responses)	**Question 4** (85 responses)
Top three themes	Religion (29)	Climate change/global warming (18)	Film made students feel a professional responsibility to a certain task/ action (33)	Described consequences of the films neurotechnology (50)
	Students did not understand the film (19)	Described consequences of the films neurotechnology (18)	Films neurotechnology may impact future work (31)	Films neurotechnology improving the lives of disabled people (26)
	Perceived consequences of the films neurotechnology (17)	Film foreshadows human extinction (17)	Students described the consequences of the films neurotechnology (11)	Helps people consider/ demonstrates certain concepts, like human inferiority (12)/)/ Students saw film aspects as possible future (12)

Table 8 Proposed impacts of *Adam & Eve MkII*

	Question 2 (87 responses)	**Question 4** (85 responses)
Proposed impacts of film	Unspecified **(not stated whether positive or negative** (72)	Unspecified **(not stated whether positive or negative** (57)
	No impact (7)	Positive impact (11)
	Positive and negative impact (4)	Positive and negative impact (8)
	Positive impact (3)	Negative (6)
	-	No impact (3)

Table 9 The top three themes per each question for *Reboot*

	Question 1 (80 responses)	**Question 2** (87 responses)	**Question 3** (82 responses)	**Question 4** (84 responses)
Top three themes	General sentiments towards the film (28)	Students found film relatable (27)	Film made students feel a professional responsibility to a certain task/ action (64)	Helps people consider/ demonstrates certain concepts (18)
	Students disliked film/ aspects of film (18)	Film raised awareness, most often towards mental health (25)	Films neurotechnology may impact future work (5)	Disabled people may attempt treatment/experimentation (15)
	Students did not understand the film (16)	Helps people consider/ demonstrates certain concepts (22)	Students disliked shock therapy (4)	Students noted technology consequences (14)

Question 2 Sample Responses: Full Set of Themes and Subthemes in the Appendix, Tables 17-40

For question 2, where students first stated whether the film had an impact on people watching it and then elaborated on their answer, students most often did not specify the exact impact the film had if they said the film had an impact.

Table 10 Proposed impacts of *Reboot*

	Question 2 (87 responses)	**Question 4** (84 responses)
Proposed impacts of film	Unspecified **(not stated whether positive or negative** (70)	Unspecified **(not stated whether positive or negative** (66)
	Negative (5)	Negative impact (12)
	Positive impact (4)	Positive and negative impact (11)
	Positive and negative impact (4)	Positive impact (4)
	No impact (4)	-

Table 11 The top three themes per each question for *The Auxiliary*

	Question 1 (30 responses)	**Question 2** (30 responses)	**Question 3** (30 responses)	**Question 4** (31 responses)
Top three themes	Pointed out specific aspects of film (10)	Helps people consider/ demonstrates certain concepts, like consequences of technology use (16)	Film made students feel a professional responsibility to a certain task/action, most often understanding someone's social reality (18)	Students described perceived consequences of films neurotechnology (10)
	Students described the consequences of the films neurotechnology (10)	Students described perceived consequences of films neurotechnology (11)	Films neurotechnology may impact future work (6)	Helps people consider/ demonstrates certain concepts, like ability expectations (8)
	Students did not understand the film (16)	Students described sentiments towards film (4)	Film had no connection to profession (3)	Film may be relatable to disabled people (4)

Table 12 Proposed impacts of *The Auxiliary*

	Question 2 (30 responses)	**Question 4** (31 responses)
Proposed impacts of film	Unspecified **(not stated whether positive or negative** (30)	Unspecified **(not stated whether positive or negative** (22)
	-	Negative impact (6)
	-	Positive impact (3)

Question 3 Sample Responses: Full Set of Themes and Subthemes in the Appendix, Tables 17-40

For question 3, students were asked to describe their thoughts about the given film regarding the profession they want to go into or are currently in and how this film may impact said profession. Most students did not identify the profession they wished to enter; of those who listed their hopeful future profession, the main profession mentioned was occupational therapy. Independent of profession, students most often noted how the film made them feel a professional responsibility towards a specific task or action, how the technology depicted in the films could impact their future work, and their opinions towards the films neurotechnology.

Question 4 Sample Responses: Full Set of Themes and Subthemes in the Appendix, Tables 17-40

For question 4, surrounding each film's impact on disabled people, students most often did not specify how the film or film content impacted disabled people. The only film that students stated had no impact on disabled people was *Adam & Eve MkII* (3).

Table 13 The top three themes per each question for *Paramusical Ensemble*

	Question 1 (84 responses)	Question 2 (86 responses)	Question 3 (84 responses)	Question 4 (87 responses)
Top three themes	Students liked film/aspects of film (65)	Helps people consider/demonstrates certain concepts, like how disability does not define ability (57)	Film made students feel a professional responsibility to a certain task/action, most commonly finding meaningful/inclusive outlets for clients (34)	Films neurotechnology improving the lives of disabled people (48)
	Helps people consider/demonstrates certain concepts (20)	Students felt film was inspiring to them/others (12)	Students felt films neurotechnology was positive, most commonly in relation to their profession (25)	Helps people consider/demonstrates certain concepts, like how disability does not define ability (31)
	Students felt films neurotechnology was positive (16)	Films neurotechnology improving the lives of disabled people (14)	Music/music therapy (16)	Students felt film was inspiring to them/others (12)

Part 2: Top Three Themes Evident in the Student Responses to Each Film

Tables 5, 7, 9, 11, 13 and 15 indicate that some top themes for each question showed up in more than one film; for example, the top theme for question 3 "Film made students feel a professional responsibility to a certain task/action" was present in all films. The top theme "Helps people consider/demonstrates certain concepts" was present in many films and a theme under more than one question with different subconnotations of different concepts, such as technology and ability. Not understanding aspects of the film was a top theme under question 1 for Adam & Eve MkII, Reboot and The Auxiliary.

Other top themes were present in only one film, for example for Question 4 "Demonstrates influence of social norms" was only present in Perfectly Natural; the theme "Disabled people may attempt treatment/experimentation" only in Reboot and "Students felt film was inspiring to them/others" only in Paramusical Ensemble. Under question 1 "religion" as a top theme was only mentioned in Adam & Eve MkII. Under question 2 "Climate change/global warming was only a top theme" in Adam & Eve MkII as was "Film foreshadows human extinction". For Reboot a top theme question 2 was "Film raised awareness, most often towards mental health" and question 3 "Students disliked shock therapy". As to Carlotta's Face top themes were linked back often specificallly to blindness.

Student Responses for the Film Perfectly Natural

There was an average of 87.5 responses to the four questions for the film *Perfectly Natural.*

For example, concerning the perceived consequences of the film's neurotechnology, students noted the film's neurotechnology may:

- "interfere with my human experience"
- "lead to less human connectivity, and therefore poorer outcomes overall in terms of health"
- "change our way of life"
- "create larger gaps of status in our society"

Concerning the concepts demonstrated by this film, students felt the film demonstrated:

Table 14 Proposed impacts of *Paramusical Ensemble*

	Question 2 (86 responses)	**Question 4** (87 responses)
Proposed impacts of film	Unspecified **(not stated whether positive or negative** (46)	Positive impact (46)
	Positive impact (39)	Unspecified **(not stated whether positive or negative** (37)
		Positive and negative impact (4)

- "[technology] can never replace organic human connection that can only built through human touch, personal interaction, and communication"
- the "struggle [to] balance between personal and professional lives, especially families with young children"

Additionally, students stated that technology could be used to care for disabled people in question 4 for the film *Perfectly Natural.* However, students noted that using the film's technology for this purpose may make disabled people feel as if they are not worthy of care and may interfere with their relationships.

Students also mentioned the theme of the COVID-19 in relation to *Perfectly Natural*, stating the film connected to the technology reliance that took place during the COVID-19 pandemic. In question 3, the importance of human interaction was emphasized in connection with the COVID-19 pandemic by students. Students also connected the technology displayed in *Perfectly Natural* to social media, with social media described from a negative perspective.

Student Responses for the Film Adam & Eve MkII

There was an average of 85 student responses to each question for the film Adam & Eve MkII.

With *Adam & Eve MkII*, students noted they felt the films neurotechnology may:

- impact the "authenticity of mankind"
- "[defeat] the purpose of human beings and the uniqueness of it"
- "do more than a human"
- "[streamline] … everyone would have all of the same abilities, there would be no differences"

Climate change and/or global warming was a theme only mentioned within the film *Adam & Eve MkII*. Within question 3 for *Adam & Eve MkII*, students noted feeling a professional responsibility to mediate the repercussions of climate change, global warming, and other negative human impacts on the planet. Additionally, students felt this film may foreshadow future events, noting that:

- "My interpretation of this film was that Earth had been destroyed, likely due to environmental issues possibly related to global warming or after an impact from space like a meteorite, killing everything living on Earth. Adam and Eve, adhering to a biblical perspective, are the first human-like AI robots and were built to function as humans on a different planet. This is a very interesting concept that unfortunately does not seem very far-fetched as the impacts of global warming are constantly affecting our Earth"
- "I do feel that this again looks at the eugenics movement and the ethical concerns around this as there will likely be very little diversity, especially if there are no human beings. This would be the extinction of the human race, which with climate change progressing as rapidly as it has, this may be a plausible event."

In the film *Adam & Eve MkII,* a common theme described was isolation, highlighting that the robots were experiencing loneliness.

Student Responses for the Film Reboot

There was an average of 83.25 student responses to each question for the film *Reboot.*

While expressing general sentiments towards the film *Reboot*, students noted that:

Table 15 The top three themes per each question for *Carlotta's Face*

	Question 1 (82 responses)	Question 2 (85 responses)	Question 3 (84 responses)	Question 4 (83 responses)
Top three themes	Film raised awareness, most often to face blindness (43)	Film helps people consider/demonstrates certain concepts, like how disability does not define ability (45)	Film made students feel a professional responsibility to a certain task/action (72)	Film helps people consider/demonstrates certain concepts, like how disability does not define ability (50)
	Students like film/aspects of film (38)	Film raised awareness, most often to face blindness (41)	Film raised awareness, most often to face blindness (13)	Students found film relatable (21)
	Film helps people consider/demonstrates certain concepts, like how disability does not define ability (27)	Students described sentiments towards film, like feeling sad for film subject (14)	Film helps people consider/demonstrates certain concepts, like how disability does not define ability (8)	Film raised awareness, most often to face blindness (30)

- "I have a lot of skepticism on the process and the probability of [electroconvulsive therapy" removing selective memories"
- "I believe the film is very gruesome however, it displays how impactful trauma can be on an individual no matter how much time has elapsed since the trauma"
- "I felt so sad for this man who is so tortured and desperate that he will try anything and doesn't seem to have any resources to help himself except what he conjures up on his own."

Many students disliked this film, sharing that:

- "It is an interesting concept of erasing the current memories to start over a new life but unrealistic and dangerous"
- "I have mixed feelings about this film as it romanticizes the use of electroconvulsive therapy (ECT) to treat mental illness, which I don't agree with"

Though every film elicited sentiments of professional responsibility towards a specific task or action for question 3, only in the film *Reboot* was *individual* responsibility mentioned, with students stating they felt individuals had a responsibility to seek mental health support.

Students noted self-medication as a theme present in the film *Reboot.* All students that identified the theme stated the film shows a type of self-medication to deal with sadness, depression, grief, and post-traumatic stress disorder. Many students noted that the film might make people attempt treatment/experimentation after viewing the film *Reboot*, and that disabled people specifically may be very likely to attempt treatment/experimentation after watching this film.

Student Responses for the Film The Auxiliary

There was an average of 30.25 student responses to each question for the film *The Auxiliary.* 56 students chose not to view the film as they perceived it to be too gruesome.

Though 56 out of 85 students chose not to view this film, as it was too gruesome, those who did frequently noted the themes of transhumanism present in this film.

Table 16 Proposed impacts of *Carlotta's Face*

	Question 2 (85 responses)	**Question 4** (83 responses)
Proposed impacts of film	Unspecified (**not stated whether positive or negative** (74)	Unspecified (**not stated whether positive or negative** (59)
	Positive impact (9)	Positive impact (23)

- "I think the situation that is demonstrated in this film needs to be taken seriously in transhumanistic developments as a potential reality."
- "I see the film as one showing the power and dominancy of the existence of technology, it controls, speaks and could decide the state of health of the users."

When discussing the impact of these films on disabled people, many considered how these technologies could affect disabled people.

- "In the past, I believe that novel medical discoveries have been trialed on disabled people and I fear that if technology like this were to be created, scientists would abuse disabled people by making them test subjects with the subtle persuasion of, 'this could create a better life for you.'"
- "[The] disabled population may be the ones to push for advancement of these AI. AI may increase the ability for many disabled people to live more independently."

Student Responses for the Film Paramusical Ensemble

There was an average of 85.25 student responses to each question for the film *Paramusical Ensemble.*

Many students reported positive emotions towards this film, with many emphasizing the positive benefits of music therapy for both disabled and non-disabled individuals.

- "I think initiatives and programs such as this one has a great impact on people with varying abilities and everyone else involved."
- "This project was able to change the lives of disabled people by giving them a way to express themselves, find their identity, and be creative. I believe that projects like the one demonstrated in the film have the potential to give the lives of severely disabled people meaning and purpose and therefore increase their overall happiness."

Student Responses for the Film Carlotta's Face

There was an average of 83.5 student responses to each question for the film *Carlotta's Face.*

There were 85 student responses to question 2. For the film *Carlotta's Face,* 74 students believed this film to be impactful but did not specify whether positive or negative; 9 students said the film had a positive impact. There were 84 responses to question 3 for *Carlotta's Face,* where students discussed feeling a professional responsibility towards a specific task or action (72), most commonly to understand and be aware of different disorders (23), awareness (13), and that the film demonstrates or helps people consider certain concepts (8), most often that we should not judge others and change how we treat others (3). Pertaining to question 4 for the film *Carlotta's Face*, out of 83 student responses, 59 students did not specify how they believed the film impacted disabled people and 23 students stated the film had a positive impact on disabled people.

As this film contained no mention of neurotechnologies and instead explored the life of a disabled individual, many students highlighted disability studies concepts in their analysis.

- "This clip does a really great job in describing invisible limitations and the oppression that tends to coexist with it. It also raises a really great point in regard to how all ages discriminate if an ability does not fit within the cultural norms that exist in that population and connects varying abilities with having a deficit. The energy of this video felt very isolating and dark, if the intention was to dis-

play how the person narrating felt they did a really good job."
- "I think this as well specifically showed those with disabilities to not let barriers the general population sees as a deal-breaker prevent you from doing things. In Carlotta's case, the status quo would not think she would be able to produce art let alone portraits if she can't visualize one, yet she proved everyone wrong"
- "The creation of these types of films can heighten awareness on the needs and feelings of disabled people and allow us to further understand how we can collectively support them."

Discussion

Question 1: What are your thoughts on the given film in general?

Our findings suggest that whether a film generates strong feelings and emotions depends on the film and the background of the viewer. In our case, one film, *The Auxiliary,* generated a very negative response due to it being seen as so gruesome that over half of the participants stopped watching it. On the other hand, the film *Paramusical Ensemble*, which showed a positive application of a neurotechnology for disabled people, generated the most positive response. This may be because the topic of brain-computer interface (BCI) as an intervention that increases the quality of life of disabled people is a sentiment that appeals to our participants, many of whom plan to go into jobs or already work in jobs with the aim to increase the quality of life of disabled people. In our case, *The Auxiliary* was much less effective in prompting the students to think about the social aspects of neurotechnologies than the other films because most students did not watch it to completion. Students often expressed that they did not understand certain parts of the films. *Paramusical Ensemble* stood out as the only film where no students indicated difficulty understanding certain aspects (Table 1), which could be attributed to the familiar subject matter portrayed. Given that all other films raised issues regarding clarity, it may be useful to have a setup where viewers are able to ask questions afterwards, whether in a festival or the classroom, to ensure that students and spectators understand the premise of the films.

With the exception of *The Auxiliary*, many students felt that the films helped people to consider and demonstrated certain concepts, indicating that showing these films is a useful pedagogical tool to stimulate discussions (Table 1). Students voiced for all films that the displayed technologies have an impact, whereby the students most often stated *Paramusical Ensemble* showcased a positive application of neurotechnology, likely a reflection again of the relatable nature of the film's content. Most students flagged the neurotechnology as negative for the film *Perfectly Natural* (Table 1). That students had different reactions to different neurotechnologies shown in the different films suggests that the films might be a useful tool to discuss the social aspects of (varied) neurotechnologies, which is seen as a goal of art [180]. That the disability studies students flagged so many different issues around the social aspects of the neurotechnologies, including for disabled people, suggests that other disability studies students would benefit from assignments that made them think about the social aspects of science and technology, including neuro-advancement, in order to become sociotechnically literate so that they can think about how to engage with science and technology, including neuro-advancement, in their role of being allies of disabled people and their goal of wanting to make a positive difference in the lives of disabled people. A valuable addition would be a setup where clarity issues students flagged could be addressed. Sense-making influences the activity of the change agent by helping identify what should be changed but also influences the very understanding of the role of change agent [327]. Our study suggests that the films facilitated sense-making for the students.

Question 2: Do you think the given film has an impact on people watching it? If yes, what impact? If not, why not?

Most students indicated that the films impact the viewers. Very few stated that the films had no impact. Students gave very concrete impact examples (Tables 7-12), although they did not categorize them necessarily as positive or negative (which was not explicitly asked for with the question). However, by looking at the concrete impacts identified, some

of them could be categorized as positive and others as negative. For example, students perceived the main impact of the film *Carlotta's Face* as bringing awareness to a 'disability' (nearly half of the impact), which some students classified as a positive impact on viewers but others did not add a label to that (Table 12), although it very likely reflects the view that raising awareness is a positive impact on viewers. Similarly, the film *Reboot* also had the theme "awareness" under the unspecified impact, so no positive or negative was attached to it. But the subthemes under awareness suggest that the students felt it was a positive impact on viewers, for example, we think it is not a stretch to think that the subtheme under awareness "Film brought awareness to disabled life/mental illness/grief/PTSD/unhappiness with life/unique life" by 16 students (Table 9) would be seen as a positive impact on viewers by the student.

The impact of the film *Paramusical Ensemble* on viewers was most frequently classified as being positive, with nearly half of students saying so. The subthemes suggest that this positive view is linked to the positive portrayal of the use of BCI as devices for disabled people and the positive depiction of 'disabled people', which allowed students to relate in a positive way to the film given that they want to see the lives of disabled people being changed in a positive way.

The film *The Auxiliary* was seen as too gruesome, thus not being watched to completion by most participants. This suggests that this film might be the least effective as an educational tool or as a tool to have students and other viewers engage with the topic of the film.

The films were part of a film festival where participants were part of post-viewing discussions but were not given questions beforehand to be used as pointers. In general, interactivity, such as discussions or Q & A's, is becoming increasingly popular in the sphere of film festivals [330, 331] although drawbacks are noted to offering interactivity [330]. Many of our participants indicated that they did not understand aspects of the films. This suggests that watching films without linked discussions or follow-up might be limiting depending on the background knowledge of the viewer. At the same time, the themes and subthemes that were voiced in response to questions 2 suggest that the films could be useful tools to trigger rich discussions after the films were watched and could help students link their role as change agents to the discussions of the technologies depicted in the films.

Question 3: Professional Applications

Neuro-advancements are one example of scientific and technological advancements that are identified as having positive potential for society but at the same time are noted to potentially pose many social and ethical problems [5–16]. As such, neuro-advancements may impact many jobs disability studies students might go into, ranging from being policymakers, educators, and allied health professionals, to working in disability advocacy and disability service organizations. Neuro-advancement might also influence the goal of being an ally to disabled people in their private lives.

Many students emphasized how technologies depicted in all films except *Carlotta's Face* could impact future work, specifically how the technologies presented in the films may eliminate or limit the demand for a certain role. Students noted that the technology depicted in the film *Adam & Eve MkII* may impact their future work the most (31), followed by *Perfectly Natural* (23) and *Paramusical Ensemble* (12). For *Adam & Eve MkII*, students felt the film's neurotechnology may force them to compete or potentially compete with technology for employment (9), that the film's neurotechnology may change/limit jobs (8), and that the ethical issues concerning the film's neurotechnology and their profession must be addressed or regulated (5). As to specific professions, physical therapy (2), occupational therapy (1), and special education teachers (1) were mentioned. Students felt that the technology in the film *Perfectly Natural* may impact their work by eliminating or limiting the need for certain jobs (11), forcing them to compete or potentially compete with technology for employment (5), and making them consider working with said technology in the future (4). Within this theme, students explicitly mentioned occupational therapy (2) and physical therapy (2). For *Paramusical Ensemble*, students noted that the film's neurotechnology may have a positive professional impact on their profession (24), that the film's neurotechnology is already used in their future profession (3), and that the film's neurotechnology may improve the lives of disabled people by giving them independence (2).

Our findings suggest that for all films that portrayed neuro-advancements, respondents felt that the neurotechnologies shown might influence their very

work. Students noted that being an advocate for inclusion was an important theme in the film *Carlotta's Face* (14), which was linked to professions like occupational therapy (6) and special needs teachers (2), upholding the role of enhancing inclusion and acceptance. Advocating for inclusion was also mentioned by students in relation to the film *Paramusical Ensemble* (2) while recognizing disability discrimination, though there was no linkage towards any specific profession. Advocacy was not mentioned as a theme in relation to the other films. The films *Carlotta's Face* and *Paramusical Ensemble* also triggered thoughts on the professional role of being a teacher/educator; discussion after the films might generate even more detailed thoughts on this theme. Given that the students suggested that their work might be impacted by neuro-advancements and given the role expectations of them, one avenue for further discussions could be to link the impacts seen by many students to the roles expected from the students in their future (envisioned) endeavors that intersect with disabled people.

Responsibility as a professional was a theme triggered by all the films, such as balancing technology and in-person interaction, understanding current technology and impacts, and supporting and validating clients. *Carlotta's Face* made students feel a professional responsibility the most (72), followed by *Reboot* (64) and *Perfectly Natural* (45). Students noted the film *Carlotta's Face* made them feel a professional responsibility to understand different disorders (23), to not pass judgment (13), and to recognize and account for disability discrimination/advocate for inclusion and acceptance (12). For *Reboot*, students described a professional responsibility to support/validate clients (18), to focus on mental health (15), and to inform clients of all treatment options (10). For *Perfectly Natural*, students felt a professional responsibility to balance technology and in-person interaction (10), to understand current technology and its impact (6), and to support/validate clients (4).

Given that our participants mentioned responsibility so often, it suggests that a discussion after the films might generate more thoughts on the topic of the responsibility of professionals and other occupation-related activities that intersect with disabled people, such as being allies to disabled people in their private lives and in their future employment, being educators, being policymakers, and working in disability service/disability advocacy organizations. The theme of responsibility students voiced could, for example, easily be applied to the expectations of what an ally ought to do, specifically in regards to educating themselves, giving disabled people a voice, and other responsibilities that are linked to being an authentic ally [78]. As previously mentioned, lifelong learning [269, 275–279] is an important tool for health professionals such as nurses [263, 264, 280, 281], social workers [282–284], speech language pathologists [261, 285, 286], and occupational therapists [287, 288]. Lifelong learning is also used in relation to active citizenship [275, 289–294], is expected from allies [78] and is said to be an increasingly important aspect to learn about neurotechnologies [332–335]. Our findings suggest that the films could be used for lifelong learning not just for health professionals but also to strengthen the role of our students as allies, to enable our students to make a positive difference in the lives of disabled people by becoming socio-technically literate and to enable our students to be involved in the governance of neurotechnologies. However, given that many of our participants indicated that they did not understand aspects of the films, hosting discussions for clarification after watching the films may be advisable. Discussions may lead to deeper engagement with the content, in turn rendering the content increasingly impactful. Discussions could be used to enrich the discourse around responsibility; for example, what is the responsibility of people involved in science and technology governance towards disabled people and society? Do they have a responsibility? What would it mean for people engaged in science and technology governance to be allies of disabled people?

Question 4: The Films and Disabled People:

Disabled people often serve as targets for the development of neuro-advancements, but many problems with neuro-advancements have been flagged over the years [46–58]. Our respondents indicated many consequences that the neurotechnologies depicted in the films could have for disabled people. Few students believed the film had no impact on disabled people.

There are many ways disabled people could be impacted by neurotechnology/neuro-advancements

besides solely as users/beneficiaries. The impacts mentioned in relation to AI/neuro, for example, are.

a) as potential users of AI/Neuro-advanced products and processes,
b) by the changing societal parameters caused by societal use of AI/Neuro-enabled products and processes,
c) by products and processes that employ AI/Neuro being able to outperform humans in a given task, and
d) by how the autonomous behavior of AI-enabled Neuro products and processes plays itself out ([336], p. 170)

This study's clearest linkage was to theme a) the role for disabled people as therapeutic users of the technology, was seen with responses to the film *Paramusical Ensemble*. Participants noted transhumanism as a theme in three films, which refers to enhancement beyond the species-typical norm; a reflection may be that most of the participants were exposed to this concept during their degree before viewing the films. Interestingly, students did not link transhumanism to the film *Paramusical Ensemble*, although the film featured BCI technology, which could be seen to provide beyond species-typical abilities to the wearer. All films led students to state that the neurotechnologies depicted could have positive and negative consequences for disabled people. It is well reported that human enhancement impacts disabled people [336–341]. Involving disabled people in post-film discussions or as content generators may diversify viewers perceptions of neuro-advancements, allowing people not linked to disabled people to see more impacts, both positive and negative, of neuro-advancements beyond a therapeutic impact.

Disabled people are one main target group for scientific and technological advancements, including neuro-advancements. It is noted that.

> "Disabled people's current situation and futures are impacted in different ways by science and technology governance and activism regarding their roles as being non-therapeutic users (consumer angle), therapeutic users (patient angle), diagnostic targets (diagnostics to prevent 'impairment' or to judge one's ability), potential arguments (preventing impairment) for science and technology governance and activism, and being impacted by changing societal parameters caused by science and technology's product vision, governance and activism (e.g., changes in ability expectations), and the negative use of science and technology (war)" ([88], p. 3).

However, it is noted that disabled artists and their art are not linked to science and technology governance, including being educators on science and technology [88].

Theme b) was reflected by participants describing how AI/neuro products may result in changing ability expectations. Students recognized that the advanced abilities provided by said technologies may result in changed societal parameters whereby the use of technology may become necessary to remain a valued member of society. This was often connected to transhumanism, where technology is used by humans to surpass species-typical abilities [339]. People who cannot afford these enhancements or refuse them can be referred to as techno-poor disabled, and as many disabled exist in a social state of disadvantage and already lack desired abilities, they will be left even further behind in the abilities rat-race [340]. Some of the impacts noted by students surrounding changing ability expectations were that changing ability expectations may result in discrimination, a change in the definition of what it means to be disabled, a divide between disabled people concerning whether they choose to pursue these advancements, and the sentiment that a disabled life is not one worth living. In their response to question 4 for the film *Adam & Eve MkII,* the technology shown was described as both positive and negative by one student:

> *"I think that this kind of technology could be beneficial to disabled people who wish to have the option to adapt their 'sub species typical' abilities would help them to gain mobility and autonomy over their body. This modification could have a negative affect because 'species typical' people could also adapt their abilities and this would create a gap in abilities."*

This shows that opinions on neurotechnology may be influenced by the conditions of their usage. This student saw that though this technology could be beneficial to

disabled people to help them meet pre-existing ability expectations, this technology could also further disadvantage disabled people (relatively) if used by non-disabled individuals. Furthermore, it was also noted that there could be disparities surrounding who can access this technology, which would in turn result in increased inequalities. One student commented that this technology would have a negative impact as.

> *"this type of technology would be very expensive and not everyone would be able to access it, which would expand on the access barriers that already exist."*.

While many students were quick to note that technology may replace their professions and eliminate certain aspects of their future career roles in question 3, students did not connect theme c) to the fact that technology may outperform disabled people in their roles, which could be an issue for the goal of occupational therapists to enable meaningful occupation for their clients [342]. It was often noted that technology may be used to care for disabled people, hence outperforming individuals in a way. However, this was often framed in the manner that technology may be used to care for disabled people not because it would outperform humans, but because humans would prefer not to care for disabled people. Concerning *Perfectly Natural,* one student noted that.

> *"Given what we see within the film I think that a lot of people would recommend something such as Future Families for a person with a learning disability. The reason I think this is because there is a lot of people that would rather not deal with people who have a learning disability and instead would place them on such technology so that they learn through the technology instead."*

While some suggested the use of technology to care for disabled people would improve the lives of disabled people, other students put forth that this would make disabled people feel they are not worthy of care and interfere with their relationships. The fact that students foresaw technology replacing their jobs but not the jobs of disabled people might be a reflection on that there are many news items that discuss the impact of technologies on jobs, like which job is in the highest danger of being replaced, but that this discussion is about the non-disabled population. As such students might simply not have been triggered through prior exposure to think about the angle of the negative impact of technologies on the jobs of disabled people and so they did not make the connection when they answered question 4. It also suggest that students were not exposed to this angle in courses they took. Students did not make the linkage between the type of jobs disabled people mostly occupy [343] and that these jobs are low-hanging fruits to be replaced by robots [343, 344]. It has been described that due to the technological overhaul of jobs, disabled people will either be forced out of work or forced to adapt, as it is noted automation will result in increasing skill requirements from human employees [345], which may be difficult depending on what the new ability requirements are. Disabled people already live in a society plagued by ability expectations they cannot meet or have to alter themselves to meet [338]. Increasing skill requirements for human employees, which are noted to be a consequence of the technological overhaul of jobs, are simply another example of changing ability expectations that disabled people may again not be able to meet or have to alter themselves to meet [345]. As such, disabled people may not only be the first to be subjected to neurotechnologies, but also the ones to experience the effect of automation on the workforce.

Theme d) was mentioned in relation to disabled people by the many comments describing the effect of technology on disabled people, specifically in relation to the consequences described in the films. For the film *Carlotta's Face,* one student noted that.

> *"This film showcases how a technology designed to make life easier, ends up having very negative consequences. This film could positively impact individuals with diverse abilities because it shows that using technology to improve aspects of your life can have a negative effect. A lot of technology is made to 'improve' individuals with diverse abilities quality of life, not taking into account how these individuals feel about their lifestyle."*

It was noted that how neurotechnologies and AI play out may have many consequences for disabled people specifically, such as changing ability expectations, interfering with human connection, and the elimination of disability/ability diversity.

Some final thoughts

We gained some important insights into the views of our participants on neuro-advancement. As to the top three themes (Tables 5, 7, 9, 11, 13, 15), some top themes for each question showed up in more than one film, and other top themes for each question were present in only one film. This result suggests that students reflected in a differentiated way on the films for each question,, which in turn is an indicator that the films were a useful tool to expose students to the social implications of neurotechnologies.

The positive feedback to the assignment suggests that using films is a good tool to expose critical disability studies students to science and technology governance, including neuro-governance discussions. Especially with follow-up activities and ways to answer the questions the films raised for students, we suggest that the films are a good tool to engage participants in neuro-governance discussions and to increase students' socio-scientific literacy on neuro-advancement. Having the data might be useful to tailor other course content to build on this insight. A lot has been written about making science students socio-scientifically literate [42–45], but little is known about the socio-scientific literacy of disability studies students. We found in our pre-search only one study [59] that asked for views of disability studies students on neurotechnologies. The breadth of thought given by our participants suggests that they had valuable insights to share, and their views indicate that they have a stake in how neurotechnologies are advanced. Therefore, the perspectives of critical disability studies students on scientific and technological advancements, including neuro-advancements, should be explored further, and these topics should be more prominently incorporated into disability studies degrees.

Limitations

Our study design is an exploratory one, and the intent was not to generate generalizable data. Indeed, results suggest many follow-up studies may be valuable to examine how different sets of participants would react to the films and answer these questions. Furthermore, this was a marked essay-style course assignment. As such, the questions were phrased to cover four broad areas that fit with the course content and objective and the background of the students. Students who are linked to other degrees, such as science and technology studies, ethics, education, engineering and health sciences, but also different disability studies degrees and years of study, or any other demography, may contribute different perspectives to this study. Furthermore, these were asynchronous classes with no live interactions. Other classes with virtual or in-person live interactions could ask follow-up questions based on what students provided as answers already and have students debate the follow-up questions in real time. Students could also ask questions that arose for them from watching the films. That would add depth to how students can make sense of the films.

Conclusion and Future Research

Our findings suggest that the films triggered students to think in a differentiated way about the subject, suggesting that these films might be useful to trigger engagement with the social aspects of neuro-advancement in the classroom. The film *The Auxiliary* was seen as too gruesome by most participants, leading many to opt out of watching the full film or responding to the questions about the film. The film *Paramusical Ensemble* elicited the most positive reaction from participants, very likely due to its topic of using technology to help disabled people in their social reality. Many students in the university-based course evaluation suggested that they enjoyed the film assignment, suggesting that showing neuro-art films might be a useful tool to engage students in discussions around the impact of neurotechnologies. Our study suggests that the films themselves sometimes lacked specificity, especially as to what impact technologies might have. Additionally, various students found certain aspects of the films confusing and in need of explanation. Follow-up discussions could clarify questions students had. Follow-up discussions would also very likely trigger more engagement with the content and the messaging of the films and would allow students to be exposed to the views of their classmates. Students in critical disability studies programs have very specific identities and understanding of self, which influenced them to join such a program. Future research could examine how students from the critical disability studies program from other universities and students from other degrees at the undergraduate and graduate levels respond to the same questions and whether

the films lead to different answers and thoughts. One could also invite people from different backgrounds to discuss the same films with the students, like disabled people and non-disabled people, students from different disability studies programs, students from non-disability studies degrees, and also disabled and non-disabled artists, all of whom would bring different expertise to the topic. We find it particularly useful within a critical disability studies degree to give space to disabled artists, as disabled artists are uniquely situated as potential content creators that can easily link advancements in science and technology, including neuro-advancements, to their lived experiences. They could also spark discussion regarding how to make a film that students could relate to and would trigger thoughts on the topic.

Future research can also focus on aspects we did not cover. For example, it would be interesting to ascertain what the views of critical disability studies students are on neurohacking (Do it yourself DIY neuro) [4], for themselves and for disabled people, whereby one could ask this for many different neuro-products. One could also make the questions more fine-grained, such as specifying under questions 3 different areas, such as being allies of disabled people, being educators, being policymakers, and working in disability service organizations, disability advocacy organizations and in allied health professions. One aspect that did not come out in the answers is the impact of the intersectionality of disabled people with other marginalized identities on how neuro-advancements are approached, perceived, and implemented. Given the importance of the intersectionality aspect for disabled people [346], this would be one aspect to explore deeper in follow-up discussions after the film screenings.

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Data Availability The datasets generated during and/or analysed during the current study are not publicly available as the ethics approval at that time did not cover such permission.

Declarations

Ethics Approval And Consent To Participate This study received ethics approval from the corresponding authors institutional review board (to be disclosed in the paper in case of acceptance) for involving human subjects.

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Appendix

The following Tables 17-40 outline the number of students mentioning a given theme or subtheme. Themes and subthemes were only noted if mentioned more than once. Tables are organized from the most mentioned themes to least mentioned themes. If a theme or subtheme was mentioned by the same number of students, alphabetical ordering was used.

Table 17 Question 1 Perfectly Natural (87)

Number of students that mentioned theme	Number of students that mentioned sub-theme
Technology consequences (44)	Films neurotechnology interfered with healthy child development (10)
	Films neurotechnology interfered with human connection (10)
	May be disparities regarding use of films neurotechnology/ access to films neurotechnology (7)

Number of students that mentioned theme	Number of students that mentioned sub-theme
	Films neurotechnology may be useful to help parents work or for the child to learn but interferes with human connection (6)
	Films neurotechnology reduced the time parents spent with children/replaced their role (6)
	Unspecified (did not give details) (5)
	Films neurotechnology changed or controlled lives (4)
	Films neurotechnology has increased the pressure to succeed professionally and forced employees to work more for their employers (4)
	Films neurotechnology fueled the push to produce skills, knowledge, and abilities (2)
	Films neurotechnology would change ability expectations (2)
	Employers used access to films neurotechnology to leverage work (2)
Helps people consider/demonstrate certain concepts (23)	Film shows technology cannot replace human connection (6)
	Film shows importance of balancing work and family (4)
	Film shows students understand wanting baby to have extra abilities/a head start in life (4)
	Film shows children in the film were being treated like technology (3)
	Film shows importance of social interaction/human touch (3)
	Film shows capitalism (2)
	Film shows motherhood is challenging (2)
Saw film/aspects of the film as a possible future (20)	This future would be scary (10)
	Technology in this film/something like it already exists (5)
	Unspecified (did not give details) (5)
Technology negative (19)	Films neurotechnology interferes with human connection (11)
	Films neurotechnology is scary, unnecessary, nerve-wracking, or unnatural (4)
	Films neurotechnology could increase/cause disability/interfere with healthy child development (2)
	Unspecified (did not give details) (2)
Influence of social norms (19)	Film shows societal pressure to produce abilities (6)
	Film shows societal pressure to work and raise children (5)
	Film shows societal pressure to succeed professionally (3)
	Film shows societal pressure to work hard and make money (2)
Sentiments towards film (16)	Creepy, disturbing, or unsettling (8)
	Irony of word "natural" (4)
	Sad for person in film (5)
	Uncomfortable/unnatural (3)
Student likes film/aspects of film (11)	-
Transhumanism (9)	Film shows transhumanism (4)
	Fim shows transhumanism consequences (4)
	Film shows ability divide due to accessibility of transhumanistic practices (3)
Film compared to other art (8)	Compared to television series *Black Mirror* (7)
Technology positive (7)	Films neurotechnology provided childcare (4)
	Films neurotechnology enhanced or developed abilities/created the perfect child (2)
	Unspecified (did not give details) (2)
Technology reliance (7)	Film shows societies technology reliance (3)
	Film shows technology reliance is negative (3)
Social media (6)	Film raises concerns surrounding social media (3)
Student has questions/feels film raises questions (5)	How far will people go with technology (2)

Number of students that mentioned theme	Number of students that mentioned sub-theme
	Other (3)
Student did not like film/aspects of film (4)	Uncomfortable with the possibility of film ideas being the future (3)
Student did not understand film/aspects of film (4)	Student only understood at end (2)
Technology risks (4)	Lack of human connection or human touch may cause disability (2)
	Dangerous (2)
COVID-19 pandemic (2)	Film connected to technology reliance during the COVID-19 pandemic (2)
Saw film/aspects of the film as an impossible future (2)	Films neurotechnology is unrealistic (2)

Table 18 Question 1 Adam & Eve MkII (84)

Number of students that mentioned theme	Number of students that mentioned sub-theme
Religion (29)	Reminded student of Adam and Eve story from bible/creation story from bible (23)
	Student thought it was interesting to see religious connection mixed with transhumanism (3)
	Student thought it was interesting to see religious connection (2)
Student did not understand film/aspects of film (19)	Student has questions/feels film raises questions (7)
	Unspecified (did not give details) (4)
	Understood after multiple watches (3)
	Understood at end (3)
	Confusing (2)
Technology consequences (17)	Films neurotechnology created ethical issues (6)
	Film raises the ethical issue of whether technology would be considered a person (3)
	Films neurotechnology eradicating disability/mortality (2)
	Domination of films neurotechnology (2)
Helps people consider/demonstrates certain concepts (15)	Film shows humans destroying planet (6)
	Film shows loneliness and togetherness (5)
	Film shows rebirth (5)
Saw film/aspects of the film as a possible future (15)	Film as possible future raises ethical issues (2)
	Film as possible future is scary (2)
	Film demonstrates possible world destruction (2)
Sentiments towards film (15)	Sad for person in film (5)
	Disturbing (3)
	Unnatural/weird (3)
Student did not like film/aspects of film (13)	Student is uncomfortable with the possibility of film ideas as future (5)
	Film is too short/needs more context (4)
	Disturbing (3)
Student likes film/aspects of film (10)	Adam and Eve concept (2)
	No dialogue (2)
	Film shows a possible future (2)
	Technology positive (2)
Film foreshadows human extinction (9)	Film shows human race will never be fully extinct (5)
	Film shows robots taking over (2)
Transhumanism (8)	Film shows transhumanism (7)
Climate change/global warming (6)	Events in the film are possible in the future due to climate change/global warming (4)
	Student believes events in the film occurred due to climate change/global warming (2)
Student has questions/feels film raises questions (6)	-
Film represents loneliness (5)	Film shows robot experiencing loneliness (3)
Symbolism and significance of Adam and Eve name (4)	-
Compared to another film (3)	Wall-E (3)
Technology negative (3)	-

Table 19 Question 1 Reboot (80)

Number of students that mentioned theme	Number of students that mentioned sub-theme
Sentiments towards film (28)	Sad for person in film (8)

Number of students that mentioned theme	Number of students that mentioned sub-theme
	Disturbing (6)
	Student prefers treatments other than shock therapy (4)
	Emotional (2)
	Far-fetched (2)
	Person in film should have sought medical attention/professional help (2)
	Student feels many individuals may want a redo (2)
Student did not like film/aspects of film (18)	Uncomfortable with ECT (6)
	Uncomfortable with erasing memories/changing who we are (6)
	Confusing (2)
	Dangerous (2)
	Disturbing (2)
Student did not understand film/aspects of film (16)	Understood at end (8)
	Student does not relate to wanting to erase memories (3)
	Unspecified (did not give details) (3)
	Confusing (2)
Relatability (15)	Viewers may relate to pain/mental illness/PTSD/desire to escape life (11)
	Student related to person in film (4)
Helps people consider/demonstrate certain concepts (14)	Film shows impact of trauma (4)
	Film helps people consider the use of shock therapy and implications (2)
	Film shows people will do anything to forget trauma (2)
	Film shows responsibility of an individual to seek mental health support (2)
Awareness (10)	Portrays/brought awareness to struggle with disabled life/mental illness/grief/PTSD/unhappiness with life/unique life (10)
Student likes film/aspects of film (10)	Student likes that film was made by one person (3)
	Unspecified (did not give details) (3)
Technology consequences (10)	Film helps people consider use of technology/shock therapy and consequences (3)
	Film highlighted techno-isolation (2)
	Films neurotechnology creates problems with responsibility/personal identity (2)
Self-medication (4)	Film shows a type of self-medication to deal with sadness/depression/grief/PTSD (4)
Student has questions/feels film raises questions (4)	Student has many questions (2)
	Student wonders if person in film would have to relearn everything (2)
Technology risks (3)	Dangerous (3)
People may attempt treatment/experimentation after viewing this film (2)	Film may encourage risky treatment (2)

Table 20 Question 1 The Auxiliary (30)

Number of students that mentioned theme	Number of students that mentioned sub-theme
Student did not view film or stopped watching the film (56)	Too gruesome (56)
Students referenced specific aspects of film (10)	Quoted "human meat bag" (6)
	Compared the auxiliary device in the film to mental illness (4)
Technology consequences (10)	Films neurotechnology changed or controlled lives (4)
Sentiments towards the film (7)	Disturbing (5)
Student did not understand film/aspects of film (7)	Understood after multiple watches (2)
	Understood at end of film (2)
	Unspecified (did not give details) (2)
Technology reliance (6)	Film shows technology reliance/helps people consider technology reliance (3)
Student likes film/aspects of film (4)	-
Transhumanism (4)	Film shows transhumanism (3)
Saw film/aspects of the film as a possible future (3)	Scary (2)

Number of students that mentioned theme	Number of students that mentioned sub-theme
Technology negative (2)	-
Student did not like film/ aspects of film (2)	-

Table 21 Question 1 Paramusical Ensemble (84)

Number of students that mentioned theme	Number of students that mentioned sub-theme
Student likes film/aspects of film (65)	Unspecified (did not give details) (17)
	Films neurotechnology is positive as it allows for disabled people to express creativity/ agency/themselves (8)
	Films neurotechnology is positive as it allows for full participation (7)
	Most enjoyable film (6)
	Nice to see people in film enjoying themselves (5)
	Films neurotechnology is positive (5)
	Student enjoys disabled people expressing creativity/agency/ themselves (3)
	Student enjoys researchers asking how participants were doing (3)
	Importance of group participation (3)
	Technology improving the lives of disabled people (3)
	Creativity (3)
	More positive than other films (2)
	Most moving film (2)
Helps people consider/demonstrate certain concepts (20)	Film shows disability does not define ability (6)
	Film shows disabled people expressing creativity/agency/ themselves (5)
	Film recognizes personhood, humanity, and autonomy of disabled people/removes stigma from disabled people (3)
	Film shows the importance of group participation (2)
	Film shows importance of recreation/participating in activities of interest for disabled people (2)
Technology is positive (16)	Films neurotechnology allows disabled people to express creativity/agency/themselves (7)
	Films neurotechnology increase accessibility (3)
	Unspecified (did not give details) (3)
	Films neurotechnology allows disabled people to overcome barriers (2)
Technology improving the lives of disabled people (12)	Films neurotechnology allows disabled people to express creativity/agency/themselves (4)
	Films neurotechnology increases accessibility for disabled people (4)
	Unspecified (did not give details) (2)
Positive impact of music/ music therapy (11)	Unspecified (did not give details) (6)
	Film shows positive impact of music/music therapy for disabled people (4)
Inspiration (5)	Film inspires people in general (4)
Awareness (2)	Brought awareness to supports for disabled people (2)
Heartwarming (2)	-
Student did not like film/ aspects of film (2)	-

Table 22 Question 1 Carlotta's Face (82)

Number of students that mentioned theme	Number of students that mentioned sub-theme
Awareness (43)	Student was unaware of face blindness before the film (31)
	Film brought awareness to a unique life/disabled life/face blindness/invisible disabilities/uncommon disabilities (13)
Student likes film/aspects of film (38)	Art outlet or self-portraits (14)
	Animation (8)

Number of students that mentioned theme	Number of students that mentioned sub-theme
	Artistry/profoundness (7)
	Creative ways Carlotta accomplished tasks in the film (6)
	Carlotta's courage (5)
Helps people consider/demonstrate certain concepts (27)	Film shows disability discrimination (7)
	Film shows we should not judge others or change how we treat others (4)
	Film shows we are unaware of the struggles of others (3)
	Film shows societal disablement experienced by individuals like Carlotta (3)
	Film shows humans are quick to judgement (3)
	Film shows that teachers are not educated surrounding disability (2)
	Film shows resilience (2)
	The film shows Carlotta's growth and her overcoming inability/social barriers through self-portraits (2)
	Film shows discrimination based on differences (2)
Sentiments towards the film (18)	Sad for person in film (13)
	Empowering (2)
Sad for person in film (13)	Due to bullying (2)
Student did not understand film/aspects of film (10)	Understood after multiple watches (3)
	Understood by the end of the film (2)
Relatability (4)	Student related to film (2)
	Viewers may relate to film (2)
Inspiration (3)	Film inspires people (3)

Table 23 Question 2 Perfectly Natural (89)

Impact	Sub-impact	Number of students that mentioned theme	Number of students that mentioned sub-theme
Unspecified (did not say positive or negative) (80)	-	Helps people consider/demonstrate certain concepts (48)	Film helps people consider the use of technology and the consequences (10)
			Film can help people consider future technology (8)
			Film allows parents to consider parenting technology (7)
			Film helps people appreciate the time they spend with their children (4)
			Film may impact mothers as their bond to children is important (3)
			Film shows the importance of balancing work and family (5)
			Film shows the importance of bonding with children (3)
			Film shows a common desire of parents for their baby to have extra abilities, and a head start in life (2)

Impact	Sub-impact	Number of students that mentioned theme	Number of students that mentioned sub-theme
			Film allows parents to consider how they raise their children (2)
			Film shows children being treated like technology (2)
			Film shows designer babies (2)
			Film shows technology cannot replace human connection (2)
	-	Technology consequences (42)	Films neurotechnology interfered with human connection (14)
			Films neurotechnology could raise ethical issues (6)
			May be disparities regarding use of films neurotechnology/access to films neurotechnology (5)
			Films neurotechnology could be used as childcare for professionals/others to help them advance their career or work more (4)
			Films neurotechnology could be used by employers to leverage work (3)
			May be disparities regarding use of films neurotechnology/access to films neurotechnology (7)
			Films neurotechnology could change ability expectations (3)
			Films neurotechnology could change or control lives (3)
			Films neurotechnology could interfere with healthy child development (2)
			Films neurotechnology could create pressure to succeed professionally (2)
			Films neurotechnology could create a push to produce abilities (2)
			Films neurotechnology could reduce time parents spend with children (2)

Impact	Sub-impact	Number of students that mentioned theme	Number of students that mentioned sub-theme
			Films neurotechnology could dominate human (2)
			Unspecified (did not give details on technology consequence) (6)
		Saw film/ aspects of the film as a possible future (14)	Scary (4)
			Films neurotechnology already exists/ something like it exists (2)
			Unspecified (did not give details on possible future) (5)
		Viewers may relate (11)	Working parents (4)
			Parents in general (3)
			Mothers may be more impacted as their bond to their children is important (3)
		Technology negative (10)	Films neurotechnology interferes with human connection (3)
			Films neurotechnology is useful to learn but may be inhumane/ unethical (2)
			Influence of social norms (9)	Film shows societal pressure to work and raise children (4, 3 referring to mothers specifically)
				Film shows societal pressure to succeed professionally/ work hard and make money (4)
				Film shows societal pressure to produce skills/ knowledge/ abilities (2)
			Sentiments towards the film (7)	Disturbing (2)
			Technology reliance (7)	Film shows technology reliance is negative (3)
				Film encourages people to stop relying on technology (2)
				Film helps people consider technology reliance (2)
				Film shows society is reliant on technology (2)
			Social media (6)	Social media connected to the film and referred to as negative (4)
			Student has questions/ feels film raises questions (5)	How far will people go with technology (3)

Impact	Sub-impact	Number of students that mentioned theme	Number of students that mentioned sub-theme
		Transhumanism (5)	The person in film is a product of transhumanism (2)
		Technology positive (4)	Films neurotechnology is desired by student/may be desired by others (2)
		Awareness (2)	-
Negative (4)	-	Technology negative (4)	Films neurotechnology reduced the time parents spent with children/replaced their role (2)
Both positively and negatively impactful (3)	Negative	Technology negative (2)	-
	Positive	Technology positive (2)	-

Table 24 Question 2 Adam & Eve MkII (87)

Impact	Sub-impact	Number of students that mentioned theme	Number of students that mentioned sub-theme
Unspecified (not stated positive or negative) (72)	-	Climate change/global warming (18)	Events in film are possible due to climate change/global warming (7)
			Film helps people consider climate change/global warming and its impact (8)
			Climate change/global warming could hurt people in the future (2)
		Technology consequences (18)	Film shows technology consequences (4)
			Film raises the ethical issues of whether technology would be considered a person (3)
			Film helps people consider the use of technology and consequences (2)
			Films neurotechnology creating an emotionless world (2)
			Films neurotechnology interfering with human connection (2)
			Film shows technology can have feelings (2)
		Film foreshadows human extinction (17)	Film could make humans want to change (9)
			Film predicts robots taking over (3)
		Saw film/aspects of the film as a possible future (17)	Film shows possible future (10)
			Films neurotechnology already exists/something like it exists (2)
			Film shows a future rebirth (2)

Impact	Sub-impact	Number of students that mentioned theme	Number of students that mentioned sub-theme
		Student has questions/ feels film raises questions (8)	-
		Transhumanism (5)	Student sees a possible transhumanistic future (2)
		Religion (4)	-
		COVID-19	-
		Technology negative (2)	-
		Technology positive (2)	
		Helps people consider/ demonstrates certain concepts (35)	Film shows humans destroying planet (7)
			Film helps people consider future technology (6)
			Film shows the importance of social interaction/human touch (5)
			Films neurotechnology compared to Siri/Alexa (2)
		Sentiments towards film (23)	Sad for person in film (6)
			Confusing (3)
			Disturbing/ scary (3)
			Film is farfetched so less impactful (2)
			Film creates fear surrounding the future of humans (2)
			Films neurotechnology is desired by student/may be desired by others (2)
			Viewers may empathize with person in film (2)
No Impact (7)		Saw film/ aspects of the film as an impossible future (2)	Too futuristic/ impossible future (2)
Both positively and negatively impactful (4)	Negative	Technology negative (2)	-
	Positive	Technology positive (2)	-
Positive (3)	-	-	-

Table 25 Question 2 Reboot (87)

Impact	Sub-impact	Number of students that mentioned theme	Number of students that mentioned sub-theme
Unspecified (not stated positive or negative) (70)		Relatability (25)	Viewers may relate to pain/ mental illness/PTSD/ desire to escape life (25)
		Awareness (23)	Film brought awareness to disabled life/mental illness/grief/ PTSD/unhappiness with life/unique life (16)

Impact	Sub-impact	Number of students that mentioned theme	Number of students that mentioned sub-theme
			Film portrays struggle with disabled life/mental illness/grief/PTSD/unhappiness with life/unique life (6)
			Film brought awareness to mental health treatment (2)
		Helps people consider/demonstrate certain concepts (22)	Film shows impact of trauma (7)
			Film shows failure of healthcare system (4)
			Film shows people will do anything to forget trauma (2)
			Film shows importance of identity/sense of self/background (2)
			Film shows importance of mental health treatment (2)
		Sentiments towards the film (11)	Disturbing (3)
			Student believes everyone would like a redo sometimes (4)
			Student believes that natural healing process is better (2)
			Technology positive (6)	Fim technology improves mental health (2)
				People may want films neurotechnology to erase painful memories (2)
			Technology risks (6)	Film shows the risks of using technology to improve yourself (4)
			People may attempt treatment/experimentation after viewing this film (5)	Disabled people may attempt treatment/experimentation after viewing this film (3)
				People may attempt treatment/experimentation after viewing this film (2)
			Student did not like film/aspects of film (4)	Student is uncomfortable with erasing memories/changing who we are (3)
			Technology consequences (4)	Films neurotechnology interferes with human connection (2)
Positive (4)	-	-	-
Negative (5)	-	Disabled people may attempt treatment/experimentation after viewing this film (3)	Dangerous (3)

Impact	Sub-impact	Number of students that mentioned theme	Number of students that mentioned sub-theme
Both positively and negatively impactful (4)	Negative	-	-
	Positive	Viewers may relate to pain/mental illness/PTSD/desire to escape life (2)	-
	Unspecified (not stated positive or negative)	Awareness (2)	Film portrays struggle with disabled life/mental illness/grief/PTSD/unhappiness with life/unique life (2)
No Impact (4)		-	-

Table 26 Question 2 The Auxiliary (30)

Impact	Sub-impact	Number of students that mentioned theme	Number of students that mentioned sub-theme
Unspecified (not stated positive or negative) (30)	-	Student did not view film, did not finish watching the film (56)	Too gruesome (56)
		Helps people consider/demonstrates certain concepts (16)	Films helps people consider the use of technology and consequences (5)
			Films neurotechnology may remind people of Siri or Alexa (2)
			Importance of agency/personality/emotion/thoughts (2)
		Technology consequences (11)	Films neurotechnology could change/control lives (4)
			Films neurotechnology could lower freedom of thought/individuality/self-esteem (3)
			Films neurotechnology could dominate the world (2)
			Films neurotechnology could raise ethical issues (2)
			Unspecified (did not say what consequences) (2)
		Sentiments towards the film (4)	Disturbing/gruesome (3)
		Influence of social norms (3)	-
		Relatability (3)	Viewers may relate to aspects of film (3)
		Transhumanism (3)	Film educates about transhumanism (2)
		Saw film/aspects of the film as a possible future (2)	-
		Technology risks (2)	-

Regarding the second question about the film *The Auxiliary,* 56 students did not view this film or did not finish watching it as they believed it to be too gruesome, leaving 31 true student responses.

Table 27 Question 2 Paramusical Ensemble (86)

Impact	Sub-impact	Number of students that mentioned theme	Number of students that mentioned sub-theme
Unspecified (not stated positive or negative) (46)	-	Helps people consider/ demonstrates certain concepts (35)	Film shows disability does not define ability (13)
			Film recognizes personhood, humanity, and autonomy of disabled people/removes stigma from disabled people (7)
			Film shows importance of communication/social support (3)
			Film shows importance of recreation/ participating in activities of interest for disabled people (3)
			Film shows we should support and accept disabled people (3)
			Film shows importance of researching technology that will impact mental wellbeing/ the lives of disabled people (2)
			Film shows resilience (2)
			Film shows various abilities are valuable/disabled people are valuable (2)
			Film shows we should include disabled people/ find ways to include disabled people (2)
		Inspiration (12)	Film inspires people in general (4)
			Fim may inspire people to create technology for disabled people (3)
		Technology improving the lives of disabled people (8)	Films neurotechnology aiding communication for disabled people (2)
			Films neurotechnology improving accessibility for disabled people (2)
		Positive impact of music/ music therapy (7)	Positive impact of music/ music therapy in general (5)
			Positive impact of music/ music therapy for disabled people (2)
		Awareness (5)	Film brought awareness to supports for disabled people (3)

Impact	Sub-impact	Number of students that mentioned theme	Number of students that mentioned sub-theme
			Film brought awareness to unique life/ disabled life (2)
		Sentiments towards film (4)	Nice to see participants/family members smiling (6)
		Technology positive (3)	-
		Films neurotechnology is desired by student/ may be desired by others (2)	Films neurotechnology should be funded as it improves the lives of disabled people (2)
Positive (39)	-	Helps people consider/ demonstrates certain concepts (22)	Film recognizes personhood, humanity, and autonomy of disabled people/removes stigma from disabled people (6)
			Film shows disability does not define ability (6)
			Film shows disabled people can do anything with support (2)
			Film shows societal disablement/social construct of disability (2)
			Film shows we should include disabled people/ find ways to include disabled people (2)
			Sentiments towards film (7)	Nice to see people in film enjoying themselves (6)
		Technology positive (7)	Films neurotechnology creates hope for disabled people (2)
			Unspecified (did not say what the positive is)
		Awareness (6)	Film brought awareness to supports for disabled people (5)
		Technology improving the lives of disabled people (6)	Films neurotechnology allowing disabled people express creativity/ agency/themselves (2)
			Films neurotechnology improving accessibility for disabled people (2)
		Positive impact of music/ music therapy (4)	Positive impact of music/ music therapy for disabled people (2)
			Positive impact of music therapy in general (2)
		Inspiration (2)	Film may inspire people to create technology for disabled people (2)

Table 28 Question 2 Carlotta's Face (85)

Impact	Sub-impact	Number of students that mentioned theme	Number of students that mentioned sub-theme
Unspecified (not stated positive or negative) (74)	-	Helps people consider/ demonstrates certain concepts (45)	Film shows we should not judge others/ change how we treat others (21)
			Film shows disability discrimination (13)
			Film shows the impact of bullying (3)
			Film shows advocacy (2)
			Film shows isolation (2)
			Film shows that identity is more than appearance (2)
			Film shows the person in film breaking social barriers (2)
			Film shows it is not only children responsible for bullying (2)
			Film shows we are unaware of others struggles (2)
		Awareness (41)	Film brought awareness to a unique life/ disabled life/ face blindness/invisible disabilities/ uncommon disabilities (39)
			Film inspired student to research face blindness (4)
		Sentiments towards the film (14)	Sad for person in film (5)
			The film was emotional (4)
		Relatability (8)	Viewers may relate to bullying
Positive (9)	-	Awareness (5)	Film brought awareness to a unique life/ disabled life/ face blindness/invisible disabilities/ uncommon disabilities (5)

Table 29 Question 3Perfectly Natural (87)

Number of students that mentioned theme	Number of students that mentioned sub-theme	Careers mentioned
Responsibility as a professional (45)	To balance technology and in-person interaction (10)	Occupational therapy (3)
	To understand current technology and impacts (6)	Occupational therapy (5)
	To support/validate clients (4)	Occupational therapy (2)
	To consider how occupation impacts health and wellbeing (3)	Occupational therapy (3)
	To consider technology ethics (3)	-
	To understand positives and negatives of technological advancements (3)	-

Number of students that mentioned theme	Number of students that mentioned sub-theme	Careers mentioned
	To consider and account for importance of human interaction/relationships/physical connection/family (2)	Occupational therapy (2)
	To educate others about technology (2)	-
	To ensure access to technology regardless of cost/background (2)	Occupational therapy (1) and occupational therapy/ "special needs teacher" (1)
	To include families in practice with consent/encourage them to be part of client's life (2)	-
	To not exploit colleagues/staff/clients (2)	Unspecified (did not mention career) (2)
	To respect individuality	-
	To understand how families may react to treatment (2)	-
	To understand how parenthood impacts health and wellbeing (2)	-
	To support variabilities and ability security (2)	-
Technology depicted in this film could impact future work (23)	Films neurotechnology eliminating or limiting the need for certain jobs (11)	Occupational therapy (2)
		Physical therapy (2)
		Unspecified (did not mention career) (2)
	Films neurotechnology forcing the students to compete/consider competing with technology for employment (5)	Teacher (3)
	Films neurotechnology makes students consider working with technology in the future (4)	Occupational therapy (2)
	Films neurotechnology aiding the communication of those they work with (2)	-
	Films neurotechnology changing ability expectations (2)	-
Technology consequences (11)	Films neurotechnology may interfere with healthy child development (8)	Teacher (3)
	Films neurotechnology may change ability expectations (2)	-
	May be disparities regarding use of films neurotechnology/access to films neurotechnology (2	-
	Films neurotechnology may improve the lives of disabled people (2)	-
Technology negative (8)	Films neurotechnology may interfere with human connection (3)	-
	Films neurotechnology may have a negative professional impact (3)	-

Number of students that mentioned theme	Number of students that mentioned sub-theme	Careers mentioned
	Films neurotechnology reliance is negative (3)	
COVID-19 pandemic (5)	Film connected to technology reliance during the COVID-19 pandemic (3)	-
	Importance of human interaction connected to the COVID-19 pandemic (3)	-
Transhumanism (5)	-	-
Saw film/aspects of the film as a possible future (4)	-	-
Helps people consider/demonstrates certain concepts (12)	Film shows the importance of social interaction/human touch (7)	-

Table 30 30 Question 3Adam & Eve Mk II (84)

Number of students that mentioned theme	Number of students that mentioned sub-theme	Careers mentioned
Responsibility as a professional (33)	To support/validate clients (5)	-
	To consider technology ethics (4)	-
	To understand current technology and impacts (9)	Occupational therapy (4)
	To understand transhumanism (3)	Occupational therapy (3)
	To care for the environment (3)	-
	To balance technology and in-person interaction (2)	-
	To adapt and anticipate technology limiting/changing jobs and realign values (2)	-
	To consider and account for the importance of human interaction/physical connection/relationships (2)	
	To support variabilities and ability security (3)	
	To mediate the repercussions of climate change/global warming/other negative human habits (3)	-
	To be open minded/have good communication (2)	Occupational therapy (2)
	To understand positives and negatives of technological advancements (7)	Occupational therapy (2)
Technology depicted in this film could impact future work (31)	Films neurotechnology forcing the students to compete/consider competing with technology for employment (9)	Occupational therapy (2)
	Films neurotechnology may change/limit jobs (8)	Physical therapy (2)
		Occupational therapy (1) and occupational therapy/ “special needs teacher” (1)

Number of students that mentioned theme	Number of students that mentioned sub-theme	Careers mentioned
	Must address ethical issues/ develop ethics guidelines for films neurotechnology (5)	Master's in public policy and work for government (2)
	Unspecified (did not give concrete impact example) (4)	-
	Films neurotechnology makes students consider working with technology in the future (4)	Occupational therapy (4)
Technology consequences (11)	Films neurotechnology limiting/ changing jobs (4)	
	Films neurotechnology cannot replace human connection (2)	-
No connection to profession (9)	-	Occupation therapy (3)
Technology positive (8)	Positive professional impact of films neurotechnology (6)	-
	Films neurotechnology is desired by student/may be desired by others (2)	-
Transhumanism (6)	Film shows transhumanism (2)	
Saw film/aspects of the film as a possible future (3)	-	-
Student has questions/feels film raises questions (2)	-	-
Technology reliance (2)	Technology reliance is negative (2)	

Table 31 Question 3Reboot (82)

Number of students that mentioned theme	Number of students that mentioned sub-theme	Careers mentioned
Responsibility as a professional (64)	To support/validate clients (18)	Occupational therapy (5)
		Physical therapy (2)
		Unspecified (did not give career)
	To focus on mental health (15)	Occupational therapy (6)
		Working with disabled people (2)
	To inform clients of all treatment options (10)	Physical therapy (2)
	To be aware of PTSD/insight into mental health concerns (5)	Occupational therapy (3)
	To rehabilitate people following ECT/erasing memories (4)	Occupational therapy (2)
	To support/validate clients (4)	Physiotherapy (2)
	To understand client's social reality, identity, and background (4)	Unspecified (did not give career) (2)
	To not pass judgement (3)	-
	To understand different disorders (3)	Occupational therapy (2)
	To be mindful of resources for clients (2)	
	To be open minded/have good communication (2)	
	To encourage positivity/identify negative influences (2)	-
	To keep clients connected/ensure they are not isolated (2)	-

Number of students that mentioned theme	Number of students that mentioned sub-theme	Careers mentioned
	To not have biases surrounding technology (2)	-
	To rehabilitate people following shock therapy/ having their memories erased (4)	-
	To support/validate clients by respecting their autonomy (2)	-
	To understand current technology and impacts (2)	-
Technology depicted in this film could impact future work (5)	Films neurotechnology improving the lives of disabled people (2)	-
Student did not like film/aspects of film (4)	Uncomfortable with shock therapy (4)	-
Student may work with people like individual in film (4)	Will work with people who have experienced memory loss (3)	Occupational therapy (2)
Awareness (3)	Film brought awareness to a disabled life/ mental illness/ grief/PTSD/ unhappiness with life/unique life (2)	-
Encourages actions in film (3)	-	-
Responsibility as an individual (3)	To seek mental health support (3)	-
No connection to profession (2)	-	-
Technology consequences (2)	-	-
Helps people consider/demonstrates certain concepts (6)	Film shows failure of healthcare system (4)	-
	Film shows importance of mental health treatment (2)	-

Table 32 Question 3The Auxiliary (30)

Number of students that mentioned theme	Number of students that mentioned sub-theme	Careers mentioned
Student did not view film or did not finish watching the film(56)	Too gruesome (56)	-
Responsibility as a professional (18)	To understand client's social reality, identity, and background (3)	Occupational therapy (2)
	To consider technology ethics (2)	-
	To focus on the mental health of a client (2)	-
	To not strive for perfection/force people to be a certain way (2)	-
	To understand positives and negatives of technology advancements (2)	-
	To understand current technology and impacts (2)	-
Technology depicted in this film could impact future work (6)	Films neurotechnology is already used in their future profession (2)	-
	Films neurotechnology could make data collection easier (2)	-
No connection to profession (3)	-	Unspecified (did not give career) (2)

Again, as 56 students did not watch the film due to how gruesome it was and therefore did not reply to question 3, there are 30 true responses to this question

Table 33 Question 3 Paramusical Ensemble (84)

Number of students that mentioned theme	Number of students that mentioned sub-theme	Careers mentioned
Responsibility as a professional (34)	To find meaningful inclusive activities/outlets for clients (10)	Occupational therapy (2)
	To understand current technology and impacts (6)	Occupational therapy (3)
	To support/validate clients (4)	-
	To give clients the tools to succeed/not limit them (3)	-
	To help disabled people express creativity (2)	-
	To recognize and account for disability discrimination and advocate for inclusion (2)	-
	To use technology to improve clients' lives (2)	-
Technology positive (25)	Positive professional impact of films neurotechnology (15)	Occupational therapy (4)
		Teacher (3)
		Healthcare (2)
	Films neurotechnology positively impacting students' profession by improving accessibility (3)	Unspecified (did not give career) (2)
	Films neurotechnology positively impacting students' profession by aiding communication (2)	-
	Films neurotechnology positively impacting students' profession by improving the lives of disabled people (2)	-
Music/music therapy (16)	Positive impact of music/music therapy for disabled people (7)	Occupational therapy (2)
	Student wishes to incorporate music therapy into professions (8)	Occupational therapy (3)
Technology depicted in this film could impact future work (12)	Films neurotechnology already used in future profession (3)	-
	Films neurotechnology improving the lives of disabled people by giving theme independence (2)	-
	Films neurotechnology improving the lives of disabled people as it can be used for therapy (2)	-
	Films neurotechnology makes students consider working with technology in the future (3)	-
Technology improving the lives of disabled people (8)	Films neurotechnology improving the lives of disabled people by giving them independence (3)	
	Films neurotechnology allows disabled people to have meaningful occupations (2)	Occupational therapy (2)

Number of students that mentioned theme	Number of students that mentioned sub-theme	Careers mentioned
	Films neuro-technology facilitating fun for disabled people (2)	--
	Unspecified (did not give concrete example how) (2)	
No connection to profession (3)	-	Occupational therapy (3)
Saw film/aspects of the film as a possible future (2)	-	-
Helps people consider/demonstrates certain concepts (2)	Film shows disabled people overcoming barriers (2)	

There were 84 student responses to question 3 for the film *Paramusical Ensemble*

Table 34 Question 3Carlotta's Face (84)

Number of students that mentioned theme	Number of students that mentioned sub-theme	Careers mentioned
Responsibility as a professional (72)	To understand different disorders (23)	Occupational therapy (8)
		Unspecified (did not give career) (3)
		Teacher (2)
	To not pass judgement (13)	Occupational therapy (2)
		Speech-language pathologist (2)
		Unspecified (did not give career) (2)
	To recognize and account for disability discrimination and advocate for inclusion and acceptance (12)	Occupational therapy (6)
		Special needs teacher (2)
	To support/validate clients (10)	Speech-language pathologist (2)
		Occupational therapy (2)
	To understand client's social reality, identity, and background (5)	
	Educating others about different disorders (4)	-
	To be open minded/have good communication with clients (3)	-
	To advocate for disabled people (2)	-
	To help disabled people gain independence (2)	Occupational therapy (2)
	To be open mind/have good communication with future clients (3)	-
	To find meaningful inclusive activities/outlets for clients (2)	-
	To not misinterpret the actions/behaviors of disabled people (2)	-
	To support variabilities and ability security (2)	-
Awareness (13)	Film brought awareness to a unique life/disabled life/face blindness/ invisible disabilities/ uncommon disabilities (13)	-
Helps people consider/demonstrates certain concepts (8)	Film shows we should not judge others/change how we treat others (3)	-

Number of students that mentioned theme	Number of students that mentioned sub-theme	Careers mentioned
	Film shows how people with different abilities can adapt (2)	-
	Film shows we are unaware of the struggles of others (2)	-
Films impact on work (7)	Students may have to develop a unique care plan for people like Carlotta or work with people who have Carlotta's condition (7)	Occupational therapy (4)
Sentiments towards the film (4)	Sad for Carlotta (2)	-
Inspiration (4)	Film inspires people (4)	-

Table 35 Question 4Perfectly Natural (86)

Impact on disabled people	Sub-impact	Number of students that mentioned theme	Number of students that mentioned sub-theme
Unspecified (not stated positive or negative) (46)	-	Technology consequences (30)	May be disparities regarding use of films neurotechnology/access to films neurotechnology (9)
			Films neurotechnology eradicating disability (8)
			Films neurotechnology changing ability expectations (8)
			Films neurotechnology improving the lives of disabled people (5)
			Films neurotechnology could create a push to produce abilities (3)
			Films neurotechnology could enhance abilities (3)
			Films neurotechnology is ableist (2)
		Technology could be used to care for disabled people (13)	Using films neurotechnology to care for disabled people may make disabled people feel they aren't worthy of care/interfere with their relationships (8)
			Films neurotechnology could be used to care for disabled people but would be difficult (3)
		Influence of social norms (10)	Film shows changing ability expectations (3)
			Film shows societal pressure to push to produce abilities in society (2)
			Film shows ability expectations (2)
			Film shows medical model thinking (2)

Impact on disabled people	Sub-impact	Number of students that mentioned theme	Number of students that mentioned sub-theme
		Helps people consider/ demonstrates certain concepts (5)	Film shows people do not want to care for disabled children (2)
		Technology negative (4)	Films neurotechnology is inhumane/ unethical (3)
		Transhumanism (3)	Film shows transhumanism (2)
Both positively and negatively impactful (17)	Negative	Technology negative (8)	Using films neurotechnology to care for disabled people may make disabled people feel they aren't worthy of care/interfere with their relationships (3)
			May be disparities regarding use of films neurotechnology/access to films neurotechnology (2)
			Films neurotechnology interferes with human connection (2)
	Positive	Technology improving the lives of disabled people (12)	Films neurotechnology creates new opportunities for disabled people (5)
			Films neurotechnology improves accessibility (2)
			Films neurotechnology may be used as therapy or care tools for disabled people (3)
		Technology positive (4)	Films neurotechnology enhances/ develops abilities (3)
Negative (14)	-	Technology consequences (6)	Using films neurotechnology to care for disabled people may make disabled people feel they aren't worthy of care/interfere with their relationships (3)
			Films neurotechnology may change ability expectations (2)
			Films neurotechnology eradicating disability (2)
		Technology negative (5)	Films neurotechnology eradicating disability (3)
		Helps people consider/ demonstrates certain concepts (4)	Film shows disabled life is not worth living/negative view of disabled life (3)
Positive (8)	-	Technology improving the lives of disabled people (9)	Films neurotechnology may help disabled people have a family/raise children (4)

Impact on disabled people	Sub-impact	Number of students that mentioned theme	Number of students that mentioned sub-theme
			Films neurotechnology may aid communication for disabled people (3)
			Films neurotechnology may disable people to learn (2)
			Films neurotechnology may improve accessibility (2)
		Technology positive (2)	-

Table 36 Question 4Adam & Eve MkII (85)

Impact on disabled people	Sub-impact	Number of students that mentioned theme	Number of students that mentioned sub-theme
Unspecified (not stated positive or negative) (57)	-	Technology consequences (38)	Films neurotechnology eradicating disability/mortality (18)
			Films neurotechnology changing ability expectations (5)
			Wealth or other disparities regarding eradicating disability/mortality/enhancing abilities (4)
			Films neurotechnology does not change social barriers (3)
			Films neurotechnology enhancing abilities/develops abilities for disabled people (3)
			Films neurotechnology raises ethical issues surrounding autonomy and consent (3)
			Films neurotechnology raises ethical issues such as who would be allowed to use said technology (3)
			Films neurotechnology's eradication of disability/mortality shows disabled life is not worth living/creates a negative view of disabled life (2)
		Helps people consider/demonstrates certain concepts (12)	Siri/Alexa mentioned in relation to films neurotechnology/that they are useful for disabled people (2)
			Film shows disabled life is not worth living/negative view of disabled life (2)

Impact on disabled people	Sub-impact	Number of students that mentioned theme	Number of students that mentioned sub-theme
			Film shows negative view of biological human bodies (2)
		Technology improving the lives of disabled people (12)	Films neurotechnology gives disabled people independence (3)
			Unspecified (did not give example) (3)
			Films neurotechnology gives disabled people equal opportunities/ overcome barriers (2)
			Films neurotechnology improving disabled people's lives as they are no longer constrained to biological bodies (2)
		Transhumanism (8)	Film shows transhumanism (5)
			Film shows transhumanism changing ability expectations (4)
		Student has questions/ feels film raises questions (5)	Would disabled people be allowed/ encouraged to use films neurotechnology (2)
		Climate change/ global warming (4)	Disabled people are more vulnerable to climate change/global warming (4)
			Saw film/ aspects of the film as a possible future (4)
			Films neurotechnology already exists/ something like it exists (3)
		Technology positive (3)	Films neurotechnology is desired by student/may be desired by others (2)
		Designer babies (2)	Designer babies will impact disabled people (2)
		Film foreshadows human extinction (2)	-
		Technology reliance (2)	-
Positive (11)	-	Technology improving the lives of disabled people (8)	Unspecified (did not give example) (3)
			Films neurotechnology allows disabled people to no longer be constrained to a biological body (2)
		Transhumanism (2)	Film shows transhumanism (2)
Negative (6)	-	Technology consequences (6)	Films neurotechnology eradicating disability/ mortality (3)
			Films neurotechnology changing ability expectations (2)

Impact on disabled people	Sub-impact	Number of students that mentioned theme	Number of students that mentioned sub-theme
			Films neurotechnology's eradication of disability/mortality shows disabled life is not worth living/creates a negative view of disabled life (2)
Both positively and negatively impactful (8)	Positive	Technology improving the lives of disabled people (6)	Films neurotechnology allows disabled people to no longer be constrained to a biological body (2)
			Films neurotechnology gives disabled people independence (2)
		Technology consequences (2)	-
	Negative	Technology consequences (4)	Wealth or other disparities regarding eradicating disability/mortality/enhancing abilities (3)
		Technology negative (2)	-
		Transhumanism (2)	-
No impact (3)	-	Reincarnation (2)	No impact on people with disabilities as film depicts reincarnation (2)

Table 37 Question 4Reboot (84)

Impact on disabled people	Sub-impact	Number of students that mentioned theme	Number of students that mentioned sub-theme
Unspecified (not stated positive or negative) (74)	-	Helps people consider/demonstrates certain concepts (18)	Film shows disabled life is not worth living/negative view of disabled life (2)
			Film shows we should support and accept disabled people (2)
			Film shows the importance of communication/social support (2)
		Disabled people may attempt treatment/experimentation after viewing this film (11)	Unspecified (7)
			Dangerous (2)
			Shows we should accept and support disabled people (2)
		Technology consequences (11)	Disabled people may be forced to use films neurotechnology (2)
			Films neurotechnology raises ethical issues (2)
			Unchanged social barriers (2)

Impact on disabled people	Sub-impact	Number of students that mentioned theme	Number of students that mentioned sub-theme
		Awareness (8)	Film brought awareness to disabled life/ mental illness/ grief/PTSD/ unhappiness with life/ unique life (8)
		Relatability (7)	Disabled people may relate to wanting to live a normal life (3)
			Disabled people may relate for other reasons (2)
		Technology risks (5)	Films neuro-technology may be dangerous (3)
			May make disabled people be scared to use technology to enhance their lives (2)
		Experiences of disabled people (3)	Disabled people experience trauma more often (2)
		Technology improving the lives of disabled people (3)	Films neuro-technology enhancing/ developing abilities for disabled people (2)
		Technology positive (3)	-
		Transhumanism (3)	Film shows consequences of transhumanism (2)
			Film shows transhumanism improving mental health (2)
		Student did not like film/aspects of film (2)	Student is uncomfortable with erasing memories/ believes in natural healing process (2)
Negative (12)		Insulting to disabled people (5)	Memory loss/ relearning would not be easy (3)
		Disabled people may attempt treatment/ experimentation after viewing this film (4)	Dangerous (4)
		Technology consequences (3)	-
Both positively and negatively impactful (11)	Positive	Technology improving the lives of disabled people (4)	-
		Relatability (3)	Viewers may relate to pain/ mental illness/ PTSD/desire to escape life (2)
		Awareness (2)	Film brought awareness to disabled life/ mental illness/ grief/PTSD/ unhappiness with life/ unique life (2)
	Negative	Insulting to disabled people (2)	Film shows disabled life is not worth living/negative view of disabled life (2)
Positive (4)	-	-	-

Table 38 Question 4The Auxiliary (30)

Impact on disabled people	Sub-impact	Number of students that mentioned theme	Number of students that mentioned sub-theme
Unspecified (not stated positive or negative) (22)	-	Student did not view the film or did not finish watching the film (56)	Too gruesome (56)
		Technology consequences (10)	May be disparities regarding use of films neurotechnology/access to films neurotechnology (2)
			Films neurotechnology may result in changing ability expectations that would further stigmatize the existence of disabled people (2)
			Disabled people may be test subjects for technological advancements like the films neurotechnology (2)
		Helps people consider/demonstrates certain concepts (8)	Film shows ability expectations (2)
		Relatability (4)	Disabled people may relate as auxiliary was compared to mental illness (2)
		Technology improving the lives of disabled people (3)	-
Negative (6)	-	Insulting to disabled people (3)	-
Positive (3)	-	Technology improving the lives of disabled people (2)	Disabled people may want to push for technology advancements like the films neurotechnology (2)
			Films neurotechnology may give disabled people independence (2)

Table 39 Question 4Paramusical Ensemble (87)

Impact on disabled people	Sub-impact	Number of students that mentioned theme	Number of students that mentioned sub-theme
Positive (46)	-	Technology improving the lives of disabled people (27)	Films neurotechnology allows for self-expression for disabled people/helps them reach musical and creative potential (8)
			Films neurotechnology may improve accessibility for disabled people (4)
			Unspecified (not stated how) (4)
			Films neurotechnology allows for independence for disabled people (3)

Impact on disabled people	Sub-impact	Number of students that mentioned theme	Number of students that mentioned sub-theme
			Films neurotechnology gives disabled people equal opportunities/helps them overcome barriers (3)
			Films neurotechnology allows for full participation for disabled people (2)
			Films neurotechnology may aid communication for disabled people (2)
			Films neurotechnology may give disabled people new opportunities (2)
		Helps people consider/demonstrates certain concepts (21)	Film shows disability does not define ability (4)
			Film recognizes personhood, humanity, and autonomy of disabled people/removes stigma from disabled people (4)
			Film shows the importance of agency (2)
			Film shows the importance of group participation (2)
			Film shows we can make life meaningful/desirable for disabled people (2)
			Film shows we should include disabled people/find ways to include disabled people (2)
		Inspiration (9)	Film may inspire disabled people to try new things (6)
			Film is inspirational for disabled people (2)
		Positive impact of music/music therapy (5)	Positive impact of music/music therapy for disabled people (4)
		Awareness (4)	Film brought awareness to supports for disabled people (2)
		Technology positive (4)	Films neurotechnology presents a hope/cure for disabled people (4)
			Films neurotechnology is desired by student/may be desired by others
		Transhumanism (2)	-
Unspecified (not stated positive or negative) (37)	-	Technology improving the lives of disabled people (21)	Films neurotechnology allows for full participation for disabled people (4)

Impact on disabled people	Sub-impact	Number of students that mentioned theme	Number of students that mentioned sub-theme
			Films neurotechnology allows for self-expression for disabled people/helps them reach musical and creative potential (4)
			Films neurotechnology improves accessibility for disabled people (3)
			Films neurotechnology gives equal opportunities for disabled people/helps them overcome barriers (3)
			Unspecified (not stated how) (3)
			Films neurotechnology allows disabled people to express creativity/agency/themselves (2)
			Films neurotechnology allows disabled people to have meaningful occupations (2)
		Helps people consider/demonstrates certain concepts (10)	Film recognizes personhood, humanity, and autonomy of disabled people/removes stigma from disabled people (3)
			Film shows disability does not define ability (5)
		Awareness (6)	Film brought awareness to supports for disabled people (4)
		Technology is positive (6)	Films neurotechnology presenting a hope/cure for disabled people (3)
		Technology consequences (5)	Wealth or other disparities regarding eradicating disability/mortality/enhancing abilities (2)
			Films neurotechnology was only available to people who knew music (2)
		Inspiration (3)	Fim may inspire people to create technology for disabled people (2)
		Positive impact of music/music therapy (3)	Positive impact of music/music therapy for disabled people (2)
Both positively and negatively impactful (4)	Positive	Technology improving the lives of disabled people (4)	Unspecified (not stated how) (2)
		Sentiments towards film (2)	Film is empowering (2)

Impact on disabled people	Sub-impact	Number of students that mentioned theme	Number of students that mentioned sub-theme
	Negative	Technology consequences (3)	Wealth or other disparities regarding eradicating disability/ mortality/ enhancing abilities (2)

Table 40 40 Question 4Carlotta's Face (83)

Impact	Sub-impact	Number of students that mentioned theme	Number of students that mentioned sub-theme
Unspecified (not stated positive or negative) (59)	-	Helps people consider/ demonstrates certain concepts (40)	Film shows we should not judge others/ we should change how we treat others (10)
			Film shows disability discrimination (10)
			Film shows resilience (4)
			Film shows societal disablement (3)
			Film shows that disability does not define ability (3)
			Film shows a strength based or empowering approach (3)
			Film shows a meaningful inclusive activities/ outlets for disabled people to express abilities (2)
		Relatability (21)	Film shows importance of understanding impact of ability expectations and variations (2)
			Film shows advocacy (2)
			Disabled people may relate to loneliness (2)
			Helps disabled people realize they are not alone (2)
		Awareness (17)	Film brought awareness to a unique life/ disabled life/ face blindness/invisible disabilities/ uncommon disabilities (14)
			Film brought awareness to disability rights and knowledge (2)
			Film brought awareness to supports for disabled people (2)
		Inspiration (9)	Film may inspire disabled people to use ability variations creatively (3)
			Film may inspire disabled people to try new things (3)
			Film is inspirational for disabled people (2)

Impact	Sub-impact	Number of students that mentioned theme	Number of students that mentioned sub-theme
Positive (23)	-	Awareness (13)	Film brought awareness to a unique life/ disabled life/ face blindness/invisible disabilities/ uncommon disabilities (12)
		Helps people consider/ demonstrates certain concepts (10)	Film shows disability discrimination (3)
			Film shows advocacy for disabled people (2)
			Film shows art to cope with disability (2)
			The film shows how Carlotta fought for rights and needs with strength and courage (2)
		Relatability (7)	Helps disabled people realize they are not alone (2)

References

1. Kies A et al (2024) Wired for work: Brain-computer interfaces' impact on frontline employees' well-being. J Serv Manage. https://doi.org/10.1108/JOSM-03-2024-0098
2. Brandt-Rauf PW, Ayaz H (2024) Occupational health and neuroergonomics: The future of wearable neurotechnologies at the workplace. Occup Environ Med 66(6):456–460. https://doi.org/10.1097/JOM.0000000000003080LWW
3. Gramann K et al (2024) Editorial: Open science to support replicability in neuroergonomic research. Front Neuroergon 5:1459204. https://doi.org/10.3389/fnrgo.2024.1459204
4. Seyfried G, Youssef S, Schmidt M (2023) Pioneering neurohackers: Between egocentric human enhancement and altruistic sacrifice. Front Neurosci 17(1188066):1–16. https://doi.org/10.3389/fnins.2023.1188066
5. Colangelo C (2024) A comprehensive guide to neuroethical approaches: A review of the methods of neuroethics. AJOB Neurosci 15(4):290–291. https://doi.org/10.1080/21507740.2024.2402226
6. Racine E, Senghor AS (2024) Diversity in neuroethics: Which diversity and why it matters? In: Farisco M (ed) Neuroethics and cultural diversity. Wiley, p 55–75. https://onlinelibrary.wiley.com/doi/chapter-epub/10.1002/9781394257522.ch4
7. Evers K (2024) Fundamental neuroethics. ISTE-Wiley, London. https://onlinelibrary.wiley.com/doi/10.1002/9781394257522.ch3
8. Jotterand F (2024) Neuroethics as an anthropological project. In: Farisco M (ed) Neuroethics and cultural diversity. Wiley, p 95-106. https://doi.org/10.1002/9781394257522.ch6
9. Dubljević V, Trettenbach K, Ranisch R (2022) The sociopolitical roles of neuroethics and the case of Klotho. AJOB Neurosci 13(1):10–22. https://doi.org/10.1080/21507740.2021.1896597
10. Ienca M (2017) Hacking minds, hacking brains, hacking augmented bodies: Ethical aspects of neurohacking. Available online: https://societadineuroetica.wordpress.com/wp-content/uploads/2017/04/hacking-minds-hacking-brains-hacking-augmented-bodies-ethical-aspects-of-neurohacking.pdf. Accessed 1 Dec 2024
11. Wade M (2018) Virtuous play: The ethics, pleasures, and burdens of brain training. Sci Cult 27(3):296–321. https://doi.org/10.1080/09505431.2018.1458828
12. Ienca M, Scheibner J (2020) What is neurohacking? Defining the conceptual, ethical and legal boundaries. In: Developments in Neuroethics and Bioethics. Elsevier, p 203–231. https://doi.org/10.1016/bs.dnb.2020.03.008

13. Salles A, Farisco M (2024) Neuroethics and AI ethics: A proposal for collaboration. BMC Neurosci 25(1):41. https://doi.org/10.1186/s12868-024-00888-7
14. Weh L (2024) An integrated embodiment concept combines neuroethics and AI ethics-relational perspectives on artificial intelligence, emerging neurotechnologies and the future of work. NanoEthics 18(8):1–16. https://doi.org/10.1007/s11569-024-00457-6
15. Kritika M (2024) A comprehensive study on navigating neuroethics in Cyberspace. AI and Ethics. https://doi.org/10.1007/s43681-024-00486-7
16. Forlini C (2024) Examining the ethics of neuroscience in contemporary neuroethics. In: Farisco M (ed) Neuroethics and cultural diversity. Wiley, p 3–20. https://doi.org/10.1002/9781394257522.ch1
17. Kaebnick GE (2024) Neuroscience and society: Supporting and unsettling public engagement. Hast Cent Rep 54(1):20–23. https://doi.org/10.1002/hast.1565
18. Rommelfanger KS, Ramos KM, Salles A (2023) Conceptual conundrums for neuroscience. Neuron 111(5):608–609. https://doi.org/10.1016/j.neuron.2023.02.016
19. O'Shaughnessy MR et al (2023) Neuroethics guidance documents: Principles, analysis, and implementation strategies. J Law Biosci 10(2):1–19. https://doi.org/10.1093/jlb/lsad025
20. Nuechterlein A, Boyle Q, Illes J (2024) Reimagining expertise and neutrality towards epistemic justice in research, clinical translation, and policy: A perspective from neuroethics. In: Farina M, Lavazza A (eds) Philosophy, expertise, and the nyth of neutrality. Routledge, p 111–127. https://doi.org/10.4324/9781003374480
21. Eke D (2024) Ethics and governance of neurotechnology in Africa: Lessons From AI. JMIR Neurotechnol 3(1):e56665. https://doi.org/10.2196/56665
22. Berman KJTT (2013) Students as agents of change: Engagement between university-based art students and alternative spaces. 27(3):387–399.https://doi.org/10.1080/09528822.2013.796199
23. Cuellar MG (2021) Latina/o students as agents of change: The influence of cultural assets and college experiences. Race Ethnic Educ 24(6):789–809. https://doi.org/10.1080/13613324.2019.1579184
24. Budowle R, Krszjzaniek E, Taylor C (2021) Students as change agents for community–university sustainability transition partnerships. Sustainability (Switzerland). 13(11):1–26. https://doi.org/10.3390/su13116036
25. Mohamad ZF, Mamat MZ, Muhamad Noor MF (2021) Students as change agents for campus sustainability in Malaysian universities. Int J Sustain Higher Educ 22(1):404–422. https://doi.org/10.1108/IJSHE-06-2020-0224
26. Broersma M, Singer JB (2022) Teaching innovation and entrepreneurship: Journalism students as change agents? In: Allan S (ed) The Routledge companion to news and journalism. Routledge, p 421–429. https://doi.org/10.4324/9781003174790
27. Reeve J et al (2022) When students show some initiative: Two experiments on the benefits of greater agentic engagement. Learn Instruc 80(August):101564. https://doi.org/10.1016/j.learninstruc.2021.101564
28. Uzzell D (1979) Four roles for the community researcher. J Volunt Action Res 8(1–2):65–75. https://doi.org/10.1177/089976407900800109
29. Hoskins B, Crick RD (2010) Competences for learning to learn and active citizenship: Different currencies or two sides of the same coin? Eur J Educ 45(1):121–137. https://doi.org/10.1111/j.1465-3435.2009.01419.x
30. Hoskins B, d'Hombres B, Campbell J (2008) Does formal education have an impact on active citizenship behaviour? Eur Educ Res J 7(3):386–402. https://doi.org/10.2304/eerj.2008.7.3.386
31. Institute for the Protection and Security of the Citizen (Joint Research Centre; personal authors: Mascherini M, Jesinghaus J, Hoskins B) (2006) Measuring active citizenship in Europe. Available online: https://op.europa.eu/en/publication-detail/-/publication/04fed606-d912-44d6-8c06-5c20c62dff7a. Accessed 1 Dec 2024
32. Hoskins BL, Mascherini M (2009) Measuring active citizenship through the development of a composite indicator. Soc Indic Res 90(3):459–488. https://doi.org/10.1007/s11205-008-9271-2
33. Heggart K (2022) Australian teachers as democracy workers. In: Heggart K, Kolber S (eds) Empowering teachers and democratising schooling: Perspectives from Australia. Springer, p 129–142. https://doi.org/10.1007/978-981-19-4464-2_9
34. Heggart KR, Flowers R (2019) Justice citizens, active citizenship, and critical pedagogy: Reinvigorating citizenship education. Democracy Educ 27(1):1–9. https://democracyeducationjournal.org/home/vol27/iss1/2
35. Tomé V, De Abreu BS (2022) Crossing steam and media literacy at preschool and primary school levels: Teacher training, workshop planning, its implementation, monitoring and assessment. Media Literacy Acad Res 5(1):161–177
36. Tomé V et al (2019) Active citizenship and participation through the media: A community project focused on pre-school and primary school children. Comunicacao e Sociedade 36:101–20. https://doi.org/10.17231/comsoc.36(2019).2347
37. Kopnina H, Saari MH (2019) If a tree falls: Business students learning active citizenship from environmentalists. Educ Sci 9(4):284. https://doi.org/10.3390/educsci9040284
38. Lawson H (2001) Active citizenship in schools and the community. Curr J 12(2):163–178. https://doi.org/10.1080/09585170110050828
39. Wood B (2019) Teaching an active citizenship curriculum. Ethos 27(1):8–10
40. Wolbring G (2023) The BIAS FREE framework: A tool for science/technology and society education to increase science and risk literacy, in democratizing risk governance: Bridging science, expertise, deliberation and public values. Springer International Publishing Cham, p 79–103. https://doi.org/10.1007/978-3-031-24271-7_4
41. Hodson D (2010) Science education as a call to action. Can J Sci Math Technol Educ 10(3):197–206. https://doi.org/10.1080/14926156.2010.504478
42. Pedretti E (1999) Decision making and STS education: Exploring scientific knowledge and social responsibility

in schools and science centers through an issues-based approach. Sch Sci Math 99(4):174–181. https://doi.org/10.1111/j.1949-8594.1999.tb17471.x
43. Waks L (1989) New challenges for science, technology, and society education. Technol Soc 11(4):427–432. https://doi.org/10.1016/0160-791X(89)90028-6
44. Fensham PJ (2007) Competences, from within and without: New challenges and possibilities for scientific literacy. Geotryckeriet, Uppsala. Available online: https://eprints.qut.edu.au/12883/1/Linnaeus_Tercentenary_Symposium.pdf. Accessed 1 Dec 2024
45. Chowdhury MA (2016) The integration of science-technology-society/science-technology-society-environment and socio-scientific-issues for effective science education and science teaching. Electron J Sci Educ 20(5):19–38
46. Wolbring G (2011) Hearing beyond the normal enabled by therapeutic devices: The role of the recipient and the hearing profession. Neuroethics 6(3):607–616. https://doi.org/10.1007/s12152-011-9120-x
47. Tucker BP (1998) Deaf culture, cochlear implants, and elective disability. Hast Cent Rep 28(4):6–14. https://doi.org/10.2307/3528607
48. Sparrow R (2005) Defending deaf culture: The case of cochlear implants. J Pol Philos 13(2):135–52. https://doi.org/10.1111/j.1467-9760.2005.00217.x
49. Blume SS (2010) The artificial ear: Cochlear implants and the culture of deafness. Rutgers University Press, New Brunswick
50. Aas S, Wasserman D (2015) Brain-computer interfaces and disability: Extending embodiment, reducing stigma? J Med Ethics 42(1):37–42. https://doi.org/10.1136/medethics-2015-102807
51. Diep L, Wolbring G (2013) Who needs to fit in? Who gets to stand out? Communication technologies including brain-machine interfaces revealed from the perspectives of special education school teachers through an ableism lens. Educ Sci 3(1):30–49. https://doi.org/10.3390/educsci3010030
52. Diep L, Wolbring G. Perceptions of brain-machine interface technology among mothers of disabled children. Disab Stud Quart 2015;35(4):no page number. https://doi.org/10.18061/.v35i4.3856
53. Wolbring G, Diep L (2016) Cognitive/Neuroenhancement through an ability studies lens. In: Jotterand F, Dubljevic V (eds) Cognitive Enhancement. Oxford University Press, Oxford, UK, p 57–75. https://doi.org/10.1093/acprof:oso/9780199396818.003.0005
54. Sample M et al (2019) Brain-computer interfaces and personhood: Interdisciplinary deliberations on neural technology. J Neural Eng. https://doi.org/10.1088/1741-2552/ab39cd
55. Sample M et al (2023) Brain-computer interfaces, disability, and the stigma of refusal: A factorial vignette study. Pub Understand Sci 32(4):522–542. https://doi.org/10.1177/09636625221141663
56. Goering S (2017) Neurodiversity and neural engineering. In: Johnson S, Rommelfanger KS (eds) The Routledge handbook of neuroethics. Routlege, New York p 37–50. https://doi.org/10.4324/9781315708652
57. Goering S, Klein E (2019) Neurotechnologies and justice by, with, and for disabled people. In: Cureton A, Wasserman DT (eds) The Oxford Handbook of Philosophy and Disability. Oxford Press, Oxford, UK p 616–32. https://doi.org/10.1093/oxfordhb/9780190622879.013.33
58. Klein E et al (2015) Engineering the brain: Ethical issues and the introduction of neural devices. Hast Cent Rep 45(6):26–35. https://doi.org/10.1002/hast.515
59. Wolbring G (2024) Neuro-abilities and a good life. J Neurol Res 14(1):16-36. https://doi.org/10.14740/jnr770
60. Oliver M, Barnes C (2010) Disability studies, disabled people and the struggle for inclusion. Brit J Soc Educ 31(5):547–560. https://doi.org/10.1080/01425692.2010.500088
61. Goodley D (2012) Dis/entangling critical disability studies. Disab Soc. 28(5):631–44. https://doi.org/10.1080/09687599.2012.717884
62. Bialka CS, Morro D (2017) What's disability got to do with it? Examining ability privilege in a disability studies course. J College Char 18(1):28–45. https://doi.org/10.1080/2194587X.2016.1260478
63. Woiak J, Lang D (2012) Theory meets practice in an introduction to disability studies course. Transform J Incl Sch Pedag 25(2):96–113. https://doi.org/10.1353/tnf.2014.0023
64. Berne P, Sins Invalid. 10 Principles of Disability Justice. Available online: https://www.sinsinvalid.org/blog/10-principles-of-disability-justice and https://static1.squarespace.com/static/5bed3674f8370ad8c02efd9a/t/5f1f0783916d8a179c46126d/1595869064521/10_Principles_of_DJ-2ndEd.pdf. Accessed 1 Dec 2024
65. Mingus M (2012) Changing the framework: Disability justice. Available online: https://leavingevidence.wordpress.com/2011/02/12/changing-the-framework-disability-justice/. Accessed 1 Dec 2024
66. Ten Berne P (2018) Principles of disability justice. Women's Stud Quart 46(1/2):227–230. https://doi.org/10.1353/wsq.2018.0003
67. Project LETS. Disability justice curriculum. Available online: https://projectlets.org/disability-justice. Accessed 1 Dec 2024
68. Richardson JTE, Kletchka DC. Museum education for disability justice and liberatory access. J Museum Educ. 2022;47(2):138–149 https://doi.org/10.1080/10598650.2022.2072155
69. Moore M (2019) Disability, activism and the academy: Time for renewal? Disabil Soc 34(7/8):1025–1027. https://doi.org/10.1080/09687599.2019.1671056
70. Peters C (2023) A critical look at autism. In: People skills for behavior analysts. p 88–95. https://doi.org/10.4324/9781003300465-9
71. Walters S (2015) Toward a critical ASD pedagogy of insight: Teaching, researching, and valuing the social literacies of neurodiverse students. Res Teach Eng 49(4):340–360. https://www.jstor.org/stable/24398710
72. Williams RM, Gilbert JE. Perseverations of the academy: A survey of wearable technologies applied to autism intervention. Int J Human-Comp Stud 2020;143:N.PAG-N.PAG. https://doi.org/10.1016/j.ijhcs.2020.102485
73. Marinoudi S (2021) 'Flash of Boy' [astrapse apo agori] linguistic metaphor and social trauma in autistic experience. Anthropol Action 28(3):12–21. https://doi.org/10.3167/aia.2021.280302

74. Manning E (2018) Me Lo Dijo un Pajarito: Neurodiversity, black life, and the university as we know it. Soc Text 6(3):1–24. https://doi.org/10.1215/01642472-6917742
75. Cameron H (2023) Runners at the gates: Growing around the barriers to diagnosis in autism, adhd and SpLDs. J Disabil Stud Educ 3(2):217–241. https://doi.org/10.1163/25888803-bja10023
76. Dunn P et al (2008) Best practices in promoting disability inclusion within Canadian schools of social work. Disabil Stud Q 28(1)
77. Bjørnerås AB et al (2024) Identifying key concepts in ambassador interventions for students with disabilities in higher education: A scoping review. Int J Disabil Dev Educ 71(3):403–419. https://doi.org/10.1080/1034912X.2022.2095558
78. Wolbring G, Lillywhite A (2023) Coverage of allies, allyship and disabled people: A scoping review. Societies (2075-4698) 13(11):241. https://doi.org/10.3390/soc13110241
79. Berman K (2012) Artist as change agent: A pedagogy of practice in artist proof studio. Teach Art J 10(3):145–156. https://doi.org/10.1080/15411796.2012.685698
80. Kerrigan F, O'Reilly D, vom Lehn D (2009) Producing and consuming arts: A marketing perspective. Consumpt Mark Cult 12(3):203–207. https://doi.org/10.1080/10253860903063212
81. Müller AL (2019) Voices in the city. On the role of arts, artists and urban space for a just city. Cities 91:49–57. https://doi.org/10.1016/j.cities.2018.04.004
82. Norton WJ (1940) Modern art and social responsibility. J Philos 37(12):325–32. https://doi.org/10.2307/2018434
83. Bell LA, Desai D (2011) Imagining otherwise: Connecting the arts and social justice to envision and act for change. Equity Excel Educ 44(3):287–295. https://doi.org/10.1080/10665684.2011.591672
84. Dufour K (2002) Art as Activism, Activism as Art. Rev Pedagog Cult Stud 24(1–2):157–167. https://doi.org/10.1080/10714410212914
85. Misluk-Gervase E (2020) The role of art therapy in eating disorder advocacy. Art Ther 37(4):194–200. https://doi.org/10.1080/07421656.2020.1823783
86. Keifer-Boyd K (2003) A pedagogy to expose and critique gendered cultural stereotypes embedded in art interpretations. Stud Art Educ 44(4):315–334. https://doi.org/10.1080/00393541.2003.11651748
87. Preusser R (1973) Relating art to science and technology: An educational experiment at the massachusetts institute of technology (M.I.T.). Leonardo 6(3):199–206. https://doi.org/10.2307/1572637
88. Wolbring G, Jamal Al-Deen F (2021) Social role narrative of disabled artists and both their work in general and in relation to science and technology. Societies 11(3):article 102. https://doi.org/10.3390/soc11030102
89. Gruber DR (2020) Toward a critical neuroart for a critical neuroscience. Leonardo 53(2):123–127. https://doi.org/10.1162/leon_a_01606
90. Siler T (2015) Neuroart: Picturing the neuroscience of intentional actions in art and science. Front Hum Neurosci 9:410. https://doi.org/10.3389/fnhum.2015.00410
91. Maurides P, Behrmann M (2017) The brain as muse: Bridging art and neuroscience. Leonardo 50(2):190–191. https://doi.org/10.1162/LEON_a_01387
92. Biofaction. BIO·FICTION Science Art Film Festival 2019 Program Topic FUTUREBODY. and neurotechnologies Available online: https://bio-fiction.com/program-2/. Accessed 1 Dec 2024
93. Mütter Museum. Mind Illuminated: Art and the brain at the Mütter Museum. Available online: http://muttermuseum.org/news/mind-illuminated-art-and-the-brain-at-the-m%C3%BCtter-museum/. Accessed 1 Dec 2024
94. Walia D (2015) Entertainment vs. Edutainment: Bollywood Movies as Pedagogical Tools. Int Res J Eng Technol 2(1):139–140. https://doi.org/10.1080/09687599.2012.717876
95. Franklin-Phipps A, Smithers L (2021) Queer Black adolescence, the impasse, and the pedagogy of cinema. Educ Philos Theor 53(7):728–739. https://doi.org/10.1080/00131857.2020.1811677
96. Parkhouse H (2015) Presenting Precious Knowledge: Using film to model culturally sustaining pedagogy and youth civic activism for social studies teachers. New Educ 11(3):204–226. https://doi.org/10.1080/1547688X.2014.964431
97. Hilburn J, Buchanan LB, Journell W (2021) Discourses of immigration and the mediating influence of documentary films. Act Teach Educ 1–18. https://doi.org/10.1080/01626620.2021.1883151
98. Bittar EC (2020) Art, human rights activism and a pedagogy of sensibility: The São Paulo Human Rights Short Films Festival-Entretodos. Hum Rights Educ Rev 3(1):69–90. https://doi.org/10.7577/hrer.3743
99. Kabadayi L (2012) The role of short film in education. Procedia-social Behav Sci 47:316–320. https://doi.org/10.1016/j.sbspro.2012.06.657
100. Supper A (2014) Sublime frequencies: The construction of sublime listening experiences in the sonification of scientific data. Soc Stud Sci 44(1):34–58. https://doi.org/10.1177/0306312713496875
101. Perignat E, Katz-Buonincontro J (2019) STEAM in practice and research: An integrative literature review. Think Skills Creat 31:31–43. https://doi.org/10.1016/j.tsc.2018.10.002
102. Quigley CF, Herro D (2016) Finding the Joy in the Unknown: Implementation of STEAM Teaching Practices in Middle School Science and Math Classrooms. J Sci Educ Technol. 25(3):410–426. https://doi.org/10.1007/s10956-016-9602-z
103. Park H et al (2016) Teachers' perceptions and practices of STEAM education in South Korea. Eurasia J Math Sci Technol Educ 12(7):1739–1753. https://doi.org/10.12973/eurasia.2016.1531a
104. Harris A, de Bruin LR (2018) Secondary school creativity, teacher practice and STEAM education: An international study. J Educ Change 19(2):153–179. https://doi.org/10.1007/s10833-017-9311-2
105. Dlamini RN, Howard GR (2023) Teacher training management guidelines for improving green IT teaching intention and behavior. In: Lecture notes in networks and systems. p 742–751

106. Jantassova D et al (2022) Capacity building for engineering training and technology via STEAM education. Educ Sci 12(11). https://doi.org/10.3390/educsci12110737
107. Zhang X, Hu J (2022) A study on the learning experience of visitors of digital museums in STEAM education: From the perspective of visitors' visual evaluation. Front Psychol 13. https://doi.org/10.3389/fpsyg.2022.994693
108. Hofmann B (2021) Linking science and technology with arts and the next generation: The STEAM imaging experimental artist residency, a case study. Leonardo 54(2):185–190. https://doi.org/10.1162/leon_a_01792
109. Reyes-de-Cózar S, Ramírez-Moreno C, Barroso-Tristán JM (2022) A qualitative analysis of the educational value of commercial video games. Educ Sci 12(9):584. https://doi.org/10.3390/educsci12090584
110. Wallace M, Poulopoulos V (2022) Pursuing social justice in educational robotics. Educ Sci 12(8):article 565. https://doi.org/10.3390/educsci12080565
111. Domenici V (2022) STEAM project-based learning activities at the science museum as an effective training for future chemistry teachers. Educ Sci 12(1):article30. https://doi.org/10.3390/educsci12010030
112. Aguilera D, Ortiz-Revilla J (2021) Stem vs Steam education and student creativity: A systematic literature review. Educ Sci 11(7). https://doi.org/10.3390/educsci11070331
113. Alcaraz-Dominguez S, Barajas M (2021) Conceiving socioscientific issues in STEM lessons from science education research and practice. Educ Sci 11(5):238. https://doi.org/10.3390/educsci11050238
114. Petersen JC (1984) Citizen participation in science policy. University of Massachusetts Press Amherst, MA
115. Bandelli A, Konijn E (2011) An experimental approach to strengthen the role of science centers in the governance of science. In: Marstine J (ed) The Routledge companion to museum ethics. Routledge, New York, p 164–173. https://doi.org/10.4324/9780203815465
116. Bandelli A, Konijn EA. Public participation and scientific citizenship in the science museum in London: Visitors' perceptions of the museum as a broker. Visit Stud 2015;18(2):131–149. https://doi.org/10.1080/10645578.2015.1079089
117. van der Meij MG, Broerse J, Kupper F (2017) RRI & science museums; prototyping an exhibit for reflection on emerging and potentially controversial research and innovation. J Sci Commun 16(4):A02. https://doi.org/10.22323/2.16040202
118. Schrögel P, Kolleck A (2019) The Many Faces of Participation in Science. Sci Technol Stud 32(2):77–99. https://doi.org/10.23987/sts.59519
119. Kano K et al (2019) How science, technology and innovation can be placed in broader visions-Public opinions from inclusive public engagement activities. J Sci Commun 18(3):A02. https://doi.org/10.22323/2.18030202
120. Lynn SJ et al (2019) Designing a platform for ethical citizen science: A case study of citSci. org. citizen science: Theor Pract 4(1). https://doi.org/10.5334/cstp.227
121. Dawson E (2014) Equity in informal science education: Developing an access and equity framework for science museums and science centres. Stud Sci Educ 50(2):209–247. https://doi.org/10.1080/03057267.2014.957558
122. Ostman R et al (2013) Making meaning through conversations about science and society. Exhibitionist 32(1):42–47
123. King A (2016) Exhibition A: scientist at work: Science museums are shifting their focus away from educating and elating their audiences to fostering dialogue with scientists. EMBO Rep 17(4):486–491. https://doi.org/10.15252/embr.201642162
124. Simpson Steele J, Fulton L, Fanning L (2016) Dancing with STEAM: Creative movement generates electricity for young learners. J Dance Educ 16(3):112–117. https://doi.org/10.1080/15290824.2016.1175570
125. Herro D, Hirsch SE, Quigley C (2022) A faculty-in-residence programme: Enacting practice-based professional development in a STEAM-focused middle school. Prof Dev Educ 48(4):559–575. https://doi.org/10.1080/19415257.2019.1702579
126. Roche J et al (2021) Science communication through STEAM: Professional development and flipped classrooms in the digital age. Sci Commun 43(6):805–813. https://doi.org/10.1177/10755470211038506
127. Kind S et al (2007) Artist-teacher partnerships in learning: The in/between spaces of artist-teacher professional development. Can J Educ 30(3):839–864. https://doi.org/10.2307/20466665
128. Caeiro C, Cruz EB, Pereira CM (2014) Arts, literature and reflective writing as educational strategies to promote narrative reasoning capabilities among physiotherapy students. Physiother Theor Pract 30(8):572–580. https://doi.org/10.3109/09593985.2014.928919
129. De Carvalho Filho MA et al (2020) Medical education empowered by theater (MEET). Acad Med 95(8):1191–1200. https://doi.org/10.1097/ACM.0000000000003271
130. Acai A et al (2016) 'It's not the form; it's the process': A phenomenological study on the use of creative professional development workshops to improve teamwork and communication skills. Med Hum 42(3):173–180. https://doi.org/10.1136/medhum-2015-010862
131. Anglin C, Halpin-Healy C, Rosenfeld P (2020) Reflecting art in nursing practice: Developing visual arts programs to transform and strengthen practice. JONA 50(5):274–80. https://doi.org/10.1097/NNA.0000000000000883
132. Koch KA, Thompson JC. Laughter filled the classroom: Outcomes of professional development in arts integration for elementary teachers in inclusion settings. Learn Disabil Multidiscip J 2017;22(2). https://doi.org/10.18666/LDMJ-2017-V22-I2-8373
133. Davis S (2017) Drama and arts-based professional learning: Exploring face-to-face, online and transmedia models. Teach Educ 28(4):333–348. https://doi.org/10.1080/10476210.2017.1296830
134. Manning C. Verenikina I, Brown I (2010) Learning with the arts: What opportunities are there for work-related adult learning?. J Vocat Educ Train 62(3):209–224. https://doi.org/10.1080/13636820.2010.493221
135. Biofaction. Winners. Available online: https://bio-fiction.com/films-2019/. Accessed 1 Dec 2024

136. Cascio MA, Weiss JA, Racine E (2021) Making autism research inclusive by attending to intersectionality: A review of the research ethics literature. Rev J Autism Dev Disord 8(1):22–36. https://doi.org/10.1007/s40489-020-00204-z
137. Aspler J, Harding KD, Cascio MA (2022) Representation Matters: Race, gender, class, and intersectional representations of autistic and disabled characters on television. Stud Soc Justice 16(2):323–348. https://doi.org/10.26522/ssj.v16i2.2702
138. Kayiatos AI, Ostrove JM (2015) Minding the Body. Disabil Stud Q 35(2):8–8. https://doi.org/10.18061/dsq.v35i2.4644
139. Ellis K, Kent M, Cousins K (2024) The routledge international handbook of critical disability studies. The Routledge International Handbook of Critical Disability Studies, p 1–418
140. Liang B (2022) Divided Communities and absent voices: The search for autistic BIPOC parent blogs. Stud Soc Justice 16(2):447–469. https://doi.org/10.26522/ssj.v16i2.3407
141. Nieminen JH, Pesonen HV (2022) Anti-ableist pedagogies in higher education: A systems approach. J Univ Teach Learn Pract 19(4):1–15. https://doi.org/10.53761/1.19.4.8
142. Mahlangu JN et al. Disability studies and critical pedagogy in health professional education: Developing a community-focused inclusive workforce using lessons from South Africa. In: Lieketseng Ned et al (eds) The Routledge International Handbook of Disability and Global Health. Routledge, London, p 371–390
143. Bunch M et al (2022) Virtual reality hope machines in a curative imaginary: Recommendations for neurorehabilitation research from a critical disability studies perspective. Disabil Rehabil 44(24):7655–7663. https://doi.org/10.1080/09638288.2021.1982024
144. Santinele Martino A et al (2023) Any sort of assessment that does not contain writing a multiple-page APA style essay, count me in: Reflections on the use of playwriting assignment in a critical disability studies classroom. Can J Disabil Stud 12(3):137–162. https://cjds.uwaterloo.ca/index.php/cjds/article/view/1037
145. Selznick H (2015) Investigating students' reception and production of normalizing discourses in a disability-themed advanced composition course. Disabil Stud Quart 35(2):3–3. https://doi.org/10.18061/dsq.v35i2.4626
146. Block P et al (2005) Introducing disability studies to occupational therapy students. Am J Occup Ther 59(5):554–560. https://doi.org/10.5014/ajot.59.5.554
147. Kielhofner G (2005) Rethinking disability and what to do about it: Disability studies and its implications for occupational therapy. The American Occupational Therapy Association, Inc., p 487–496
148. Harrison EA et al (2021) Disability studies and occupational therapy: Renewing the call for change. Am J Occup Ther 75(4). https://doi.org/10.5014/ajot.2021.754002
149. Gitlow L, Flecky K (2005) Integrating disability studies concepts into occupational therapy education using service learning. Am J Occup Ther 59(5):546–553. https://doi.org/10.5014/ajot.59.5.546
150. Heffron JL et al (2019) The Bigger Picture: Occupational therapy practitioners' perspectives on disability studies. Am J Occup Ther 73(2). https://doi.org/10.5014/ajot.2019.030163
151. Wolbring G, Chai T (2016) Investigating occupational therapy: From disability studies to ability studies. In: Pollard N, Sakellariou D (eds) Occupational therapy without borders. Elsevier, Amsterdam, p 211–219
152. Frank G, Block P, Zemke R (2008) Introduction to special theme issue anthropology, occupational therapy and disability studies: Collaborations and prospects. Pract Anthropol 30(3):2–5. https://doi.org/10.17730/praa.30.3.w111362702q45003
153. Gappmayer G (2021) Disentangling disablism and ableism: The social norm of being able and its influence on social interactions with people with intellectual disabilities. J Occup Sci 28(1):102–113. https://doi.org/10.1080/14427591.2020.1814394
154. Phelan SK (2011) Constructions of disability: A call for critical reflexivity in occupational therapy. Canadian J Occup Ther 78(3):164–172. https://doi.org/10.2182/cjot.2011.78.3.4
155. Pollard N, Block P (2017) Who occupies disability? Br J Occup Ther / Cad Bras Ter Ocup 25(2):417–426 https://doi.org/10.4322/0104-4931.ctoEN18252
156. Yu B, Epstein L, Tisi V (2021) A DisCrit-informed critique of the difference vs. disorder approach in speech-language pathology, in Critical perspectives on social justice in speech-language pathology. IGI Global, p 105–128
157. Burghardt M et al (2021) Coming to critical disability studies: Critical reflections on disability in health and social work professions. Can J Disabil Stud 10(1):23–53. https://doi.org/10.15353/cjds.v10i1.743
158. Horton R (2021) Critical perspectives on social justice in speech-language pathology. Hershey, PA IGI Global
159. Roets G, Dean H, Bouverne-De Bie M (2019) Disability rights and disability studies in social work: Uncovering different interpretations of rights and needs of people with learning disabilities in social work practice. In: Lorenz W, Otto H-U (eds) European social work: A compendium, Fabian Kessl. Verlag Barbara Budrich, Leverkusen-Opladen, Germany, p 201–224. https://doi.org/10.2307/j.ctvscxsrf.14
160. Meekosha H, Dowse L (2007) Integrating critical disability studies into social work education and practice: An Australian perspective. Practice (09503153) 19(3):169–183. https://doi.org/10.1080/09503150701574267
161. Boxall K, Beresford P (2013) Service user research in social work and disability studies in the United Kingdom. Disab Soc 28(5):587–600. https://doi.org/10.3390/soc11030102
162. Galvan T. Interview: Education should be the antithesis to genocide: Gint Aras Reckons with the Burdens of History. Available online: https://thirdcoastreview.com/2020/01/12/education-should-be-the-antithesis-to-genocide-gint-aras-reckons-with-the-burdens-of-history/. Accessed 1 Dec 2024
163. Brown RM. Art for social responsibility: Stories behind artists' commitment to social justice and an analysis of

moral development in activist art. Available online: https://digitalcollections.sit.edu/capstones/265. Accessed 1 Dec 2024
164. Breckenridge J (2009) Text and the city: Design(at)ing post-dictatorship memorial sites in Buenos Aires. In: Latin American Jewish Cultural Production. p 135–154
165. Vukadin A, Wongkitrungrueng A, Assarut N (2018) When art meets mall: Impact on shopper responses. J Prod Brand Manage 27(3):277–293. https://doi.org/10.1108/JPBM-01-2017-1406
166. Johnson PM (2014) Re-accessing the power of art in the discipline of Pan-African studies. J Pan Afr Stud 7(1):99–117
167. Ulmer JB (2017) Writing urban space: Street art, democracy, and photographic cartography. Cult Stud - Crit Methodol 17(6):491–502. https://doi.org/10.1177/1532708616655818
168. Pearson HE (2017) Moving towards the trialectics of space, disability, and intersectionality: Intersecting spatiality and arts-based visual methodologies. Knowl Cult 5(5):43–68 https://doi.org/10.22381/KC5520174
169. Finley S (2011) Ecoaesthetics: Green arts at the intersection of education and social transformation. Cult Stud - Crit Methodol 11(3):306–313. https://doi.org/10.1177/1532708611409549
170. Kuttner PJ (2015) Educating for cultural citizenship: Reframing the goals of arts education. Curric Inq 45(1):69–92. https://www.jstor.org/stable/43941686
171. Mardirosian GH, Belson SI, Lewis YP (2009) Arts-based teaching: A pedagogy of imagination and a conduit to a socially just education. Curr Issues Educ 12(10):1–21
172. Nguyen H (2015) Practicing social work through fiction-writing and journalism: Stories from Vietnam. Int J Innov Creat Change 2(1):100–116
173. Ramsey P (2013) Arts and older people strategy 2010–2013, arts council of Northern Ireland. Cult Trends 22(3–4):270–277. https://doi.org/10.1080/09548963.2013.819660
174. Williams T et al (2018) The intersection of identity and performing arts for black physicists. In: Physics Education Research Conference Proceedings
175. Balint TS, Pangaro P (2016) Design space for space design: Dialogs through boundary objects at the intersections of art, design, science, and engineering. In: Proceedings of the International Astronautical Congress, IAC
176. Moss H, Donnellan C, O'Neill D (2012) A review of qualitative methodologies used to explore patient perceptions of arts and healthcare. Med Hum 38(2):106–109. https://doi.org/10.1136/medhum-2012-010196
177. Eades G, Ager J (2008) Time being: Difficulties in integrating arts in health. J R Soc Promot Health 128(2):62–67. https://doi.org/10.1177/1466424007087809
178. Nienhaus M, Dollner J (2005) Depicting dynamics using principles of visual art and narrations. IEEE Comp Graph Appl 25(3):40–51. https://doi.org/10.1109/MCG.2005.53
179. Eisner E (2008) Art and knowledge. In: Knowles JG, ALC (eds) Handbook of the arts in qualitative research: Perspectives, methodologies, examples, and issues. Sage, London, p 3–13
180. Curtis DJ (2011) Using the arts to raise awareness and communicate environmental information in the extension context. J Agricult Educ Ext 17(2):181–194. https://doi.org/10.1080/1389224X.2011.544458
181. French J. Art as advocacy: Exploring curatorial practice by learning disabled artists as a site for self-advocacy. Available online: https://etheses.whiterose.ac.uk/19432/. Accessed 1 Dec 2024
182. Bang GH, Kim KM (2015) Korean disabled artists' experiences of creativity and the environmental barriers they face. Disab Soc 30(4):543–555. https://doi.org/10.1080/09687599.2015.1030065
183. de Valck M (2016) What is a film festival? How to study festivals and why you should. In: de Valck M, Kredell B, Loist S (eds) Film festivals: History, theory, method, practice. Routledge, p 1–11. https://doi.org/10.4324/9781315637167
184. New York City Horror Film Festival. About. Available online: https://nychorrorfest.com/about/. Accessed 1 Dec 2024
185. Tales F. About. Available online: https://www.fairytalesfilmfest.com/about. Accessed 1 Dec 2024
186. Vallejo A (2020) Rethinking the canon: The role of film festivals in shaping film history. Stud Eur Cin 17(2):155–169. https://doi.org/10.1080/17411548.2020.1765631
187. Zhao J, Liu R (2021) Promoting stroke awareness through short movies and film festivals. CNS Neurosci Therapeut 27(9):991–993. https://doi.org/10.1111/cns.13710
188. Tascón S (2017) Watching others' troubles: Revisiting 'The Film Act' and spectatorship in activist film festivals. In: Tascon S, Wils T (eds) Activist film festivals: Towards a political subject. Intellect Books, p 21–37. https://doi.org/10.2307/j.ctv36xw20b
189. Huang YS (2003) Creating and distributing films openly: On the relationship between women's film festivals and the women's rights movement in Taiwan. Inter-Asia Cult Stud 4(1):157–158. https://doi.org/10.1080/1464937032000060302
190. Clark B (2007) Festival challenges stigma of disability: [Final Edition]. In: Calgary Herald. Calgary, Alta, p D8
191. Fox AM (2015) Invigorating disability aesthetics through art and performance a report from the bodies of work festival of disability arts and culture 2013. J Lit Cult Dis Stud 9(3):349–355. https://doi.org/10.3828/jlcds.2015.27
192. Snyder SL, Mitchell DT (2008) How do we get all these Disabilities in here?: Disability film festivals and the politics of atypicality. Can J Film Stud 17(1):11–29. https://doi.org/10.3138/cjfs.17.1.11
193. Gilbert ACB (2014) Brazil's International disability film festival assim vivemos. NECSUS. Eur J Media Stud 3(1):359–364. https://doi.org/10.5117/NECSUS2014.1.GILB
194. Tsakiri M (2020) Disability film festivals: The spaces where crip killjoys take action. In: Disability and dissensus: Strategies of disability representation and inclusion in contemporary culture. Brill, p 85–103. https://doi.org/10.1163/9789004424678_007
195. Strong H. How film festivals have managed the shift to virtual. Available online: https://hyperallergic.com/626125/virtual-festivals-covid-19/. Accessed 1 Dec 2024

196. Kerbe W, Schmidt M (2015) Splicing boundaries: The experiences of bioart exhibition visitors. Leonardo 48(2):128–136. https://muse.jhu.edu/article/577858
197. Meyer A, Cserer A, Schmidt M (2013) Frankenstein 20: Identifying and characterising synthetic biology engineers in science fiction films. Life Sci Soc Policy 9(1):1–17. https://doi.org/10.1186/2195-7819-9-9
198. Muslimin S et al (2019) The implementation of SETS (Science, Environment, Technology, and Society) approach through flood natural disaster mitigation. Int Educ Res 2(1):p6-p6. https://doi.org/10.30560/ier.v2n1p6
199. Usmeldi U, Amini R, Trisna S (2017) The development of research-based learning model with science, environment, technology, and society approaches to improve critical thinking of students. Jurnal Pendidikan IPA Indones 6(2):318–325. https://doi.org/10.15294/jpii.v6i2.10680
200. Martin KM, Davis LS, Sandretto S (2019) Students as storytellers: Mobile-filmmaking to improve student engagement in school science. J Sci Commun 18(5). https://doi.org/10.22323/2.18050204
201. Birdsall S (2013) Reconstructing the relationship between science and education for sustainability: A proposed framework of learning. Int J Env Sci Educ 8(3):451–478. https://doi.org/10.12973/ijese.2013.214a
202. Macalalag AZ, Johnson J, Lai M (2020) How do we do this: Learning how to teach socioscientific issues. Cult Stud Sci Educ 15:389–413. https://doi.org/10.1007/s11422-019-09944-9
203. Tucker C, Jackson KS, Park JJ (2020) Exploring the future of engineering education: Perspectives from a workshop on artificial intelligence and the future of stem and societies. In: ASEE Annual Conference and Exposition, Conference Proceedings
204. Schibeci R, Lee L (2003) Portrayals of science and scientists, and 'science for citizenship.' Res Sci Technol Educ 21(2):177–192. https://doi.org/10.1080/0263514032000127220
205. Kumar D, Berlin D (1998) A study of STS themes in state science curriculum frameworks in the United States. J Sci Educ Technol 7(2):191–197. https://doi.org/10.1023/A:1022520725386
206. Oldoni JFWB, Fortuna C, Leite RF (2019) Socio-scientific issues in didactic books of elementary science: What are the goals? Acta Sci 21(4):82–96. https://doi.org/10.17648/acta.scientiae.v21iss4id4631
207. McComas WF, Almazroa H, Clough MP (1998) The nature of science in science education: An introduction. Sci Educ 7(6):511–532. https://doi.org/10.1023/A:1008642510402
208. Kelly GJ, Brown C, Crawford T (2000) Experiments, contingencies, and curriculum: Providing opportunities for learning through improvisation in science teaching. Sci Educ 84(5):624–657. https://doi.org/10.1002/1098-237X(200009)84:5<624::AID-SCE5>3.0.CO;2-S
209. Jasanoff S (2000) Reconstructing the past, constructing the present: Can science studies and the history of science live happily ever after? Soc Stud Sci 30(4):621–631. https://doi.org/10.1177/030631200030004005
210. Aikenhead GS (1997) Student views on the influence of culture on science. Int J Sci Educ 19(4):419–428. https://doi.org/10.1080/0950069970190405
211. Weinstein M (2008) Finding science in the school body: Reflections on transgressing the boundaries of science education and the social studies of science. Sci Educ 92(3):389–403. https://doi.org/10.1002/sce.20267
212. Gonsalves AJ, et al (2019) It's not my dream, actually: Students' identity work across figured worlds of construction engineering in Sweden. Int J STEM Educ 6(1). https://doi.org/10.1186/s40594-019-0165-4
213. Bernstein MJ et al (2017) Science outside the lab: Helping graduate students in science and engineering understand the complexities of science policy. Sci Eng Ethics 23(3):861–882. https://doi.org/10.1007/s11948-016-9818-6
214. Pedretti E, Hodson D (1995) From rhetoric to action: Implementing STS education through action research. J Res Sci Teach 32(5):463–485. https://doi.org/10.1002/tea.3660320505
215. Pedretti EG et al (2008) Promoting issues-based STSE perspectives in science teacher education: Problems of identity and ideology. Sci Educ 17(8–9):941–960. https://doi.org/10.1007/s11191-006-9060-8
216. Pedretti E, Navas Iannini AM (2020) Controversy in science museums: Re-imagining exhibition spaces and practice. Controversy in Science Museums: Re-imagining Exhibition Spaces Pract 1–252
217. Feltrin RB et al (2018) For socially engaged science: The dynamics of knowledge production in the Fiocruz graduate program in the framework of the "Brazil Without Extreme Poverty Plan". PLoS One 13(10). https://doi.org/10.1371/journal.pone.0204232
218. Bulpin K, Molyneux-Hodgson S (2013) The disciplining of scientific communities. Interdiscip Sci Rev 38(2):91–105. https://doi.org/10.1179/0308018813Z.00000000038
219. Osborne J et al (2003) What "ideas-about-science" should be taught in school science? A delphi study of the expert community. J Res Sci Teach 40(7):692–720. https://doi.org/10.1002/tea.10105
220. Solomon J (1987) Social influences on the construction of pupils' understanding of science. Stud Sci Educ 14(1):63–83. https://doi.org/10.1080/03057268708559939
221. Solomon J (1992) The classroom discussion of science-based social issues presented on television: Knowledge, attitudes and values. Int J Sci Educ 14(4):431–444. https://doi.org/10.1080/0950069920140406
222. Russo J, Russo T, Roche A (2021) Using rich narratives to engage students in worthwhile mathematics: Children's literature, movies and short films. Educ Sci 11(10):588. https://doi.org/10.3390/educsci11100588
223. Mukagihana J, Nsanganwimana F (2022) Aurah CM Effect of instructional methods on pre-service science teachers learning outcomes: A meta-analysis. Educ Inform Tech 27(2):2137–2163. https://doi.org/10.1007/s10639-021-10696-9
224. Knippels MCP, Severiens SE, Klop T (2009) Education through fiction: Acquiring opinion-forming skills in the context of genomics. Int J Sci Educ 31(15):2057–2083. https://doi.org/10.1080/09500690802345888

225. Forlano L, Sedini C (2021) More than human trading zones in design research and pedagogy. In: Routledge Handbook of Art, Science, and Technology Studies. Routledge, p 198–213. https://doi.org/10.4324/9780429437069
226. Gough S, Gough N, Gough A (2022) Cyborg, goddess, or magical girl/heavenly woman? Rethinking gender and technology in science education via Ghost in the Shell. Continuum 1–14. https://doi.org/10.1080/10304312.2022.2045903
227. Dewhurst M (2014) Social justice art: A framework for activist art pedagogy. Harvard Education Press, Cambridge, Massachusetts, USA
228. Rolling JH (2016) Reinventing the STEAM Engine for Art + Design Education. Art Educ 69(4):4–7. https://doi.org/10.1080/00043125.2016.1176848
229. Stark L, Crawford K (2019) The work of art in the age of artificial intelligence: What artists can teach us about the ethics of data practice. Surveil Soc 17(3–4):442–455. https://doi.org/10.24908/ss.v17i3/4.10821
230. Bureaud A (2018) What's art got to do with it? Reflecting on bioart and ethics from the experience of the trust Me I'm an artist project. Leonardo 51(1):85–86. https://doi.org/10.1162/LEON_a_01480
231. Dumitriu A (2018) Trust Me, I'M an Artist: Building opportunities for art and science collaboration through an understanding of ethics. Leonardo 51(1):83–84. https://doi.org/10.1162/LEON_a_01481
232. Gigliotti C (2006) Leonardo's choice: The ethics of artists working with genetic technologies. AI Soc 20(1):22–34. https://doi.org/10.1007/s00146-005-0003-8
233. Vignone K. Democratizing nanotechnology: The nanoscale informal science education network and the meaning of civic education. Available online: https://ecommons.cornell.edu/bitstream/handle/1813/33884/kdv5.pdf?sequence=1&isAllowed=y.. Accessed 1 Dec 2024
234. Roeser S, Taebi B, Doorn N (2019) Geoengineering the climate and ethical challenges: What we can learn from moral emotions and art. In: Gardiner SM, McKinnon C, Fragnière A (eds) Critical Review of International Social and Political Philosophy. Routledge, London, p. 1–18. https://doi.org/10.1080/13698230.2020.1694225
235. Balmer AS et al (2016) Five rules of thumb for post-ELSI interdisciplinary collaborations. J Respons Innov 3(1):73–80 https://doi.org/10.1080/23299460.2016.1177867
236. Halfon SE et al (2020) Engaging theatre, activating publics: Theory and practice of a performance on darwin. Engaging Sci Technol Soc 6:255–282. https://doi.org/10.17351/ests2020.403
237. Last A (2012) Mutable matter: Using sensory methods in public engagement with nanotechnology. Leonardo 45(2):132–139. https://muse.jhu.edu/article/467158
238. Baker C et al (2018) WEAR: Wearable technologists engage with artists for responsible innovation: Processes and progress. Virt Creat 8(1):91–105. https://doi.org/10.1386/vcr.8.1.91_1
239. Coeckelbergh M (2018) The art, poetics, and grammar of technological innovation as practice, process, and performance. AI Soc. 33(4):501–510. https://doi.org/10.1007/s00146-017-0714-7
240. Schuijff M, Dijkstra AM (2020) Practices of responsible research and innovation: A Review. Sci Eng Ethics 26:533–574. https://doi.org/10.1007/s11948-019-00167-3
241. Reinsborough M (2020) Art-science collaboration in an EPSRC/BBSRC-Funded synthetic biology UK research centre. NanoEthics 14:93–111. https://doi.org/10.1007/s11569-020-00367-3
242. Fannin M et al (2020) BrisSynBio art-science dossier. NanoEthics 14(1):27–41. https://doi.org/10.1007/s11569-020-00368-2
243. Heras M, Ruiz-Mallén I, Gallois S (2020) Staging science with young people: Bringing science closer to students through stand-up comedy. Int J Sci Educ 42(12):1968–1987. https://doi.org/10.1080/09500693.2020.1807071
244. Torre M (2017) Impossible pictures: When art helps science education. In: 16th Conference on Applied Mathematics, APLIMAT 2017 - Proceedings
245. Coenen C (2016) Broadening discourse on responsible research and innovation (RRI). Nanoethics 10:1–4. https://doi.org/10.1007/s11569-016-0255-4
246. Göbel C et al. Report European stakeholder round table on citizen and DIY science and responsible research and innovation. Available online: https://discovery.ucl.ac.uk/id/eprint/1563626/7/Report%20on%20DITOs%20Round%20Table%20on%20Citizen%20Science%20DIY%20Science%20and%20RRI.pdf. Accessed 1 Dec 2024
247. Pansera M et al (2020) Embedding responsible innovation within synthetic biology research and innovation: insights from a UK multi-disciplinary research centre. J Respons Innov 1–26. https://doi.org/10.1080/23299460.2020.1785678
248. Szymanski E et al (2020) Crossing kingdoms: How can art open Up new ways of thinking about science? Front Bioeng Biotechnol 8. https://doi.org/10.3389/fbioe.2020.00715
249. Swierstra T, Pérez E, Efstathiou S. Getting our hands dirty with technology. Available online: https://tidsskrift.dk/peripeti/article/view/117599. Accessed 1 Dec 2024
250. Aryan V, Bertling J, Liedtke C (2020) Topology, typology, and dynamics of commons-based peer production: On platforms, actors, and innovation in the maker movement. Creat Innov Manage. https://doi.org/10.1111/caim.12392
251. Jho H (2014) Implications of science education as interdisciplinary education through the cases of scientists and artists in the modern era: Focus on the relationship between science and the arts. J Kor Assoc Sci Educ 34(8):755–765. https://doi.org/10.14697/jkase.2014.34.8.0755
252. Emdin C (2010) Affiliation and alienation: Hip-hop, rap, and urban science education. J Curri Stud 42(1):1–25. https://doi.org/10.1080/00220270903161118
253. Emdin C, Adjapong E, Levy I (2016) Hip-hop based interventions as pedagogy/therapy in STEM: A model from urban science education. J

Multicult Educ 10(3):307–321. https://doi.org/10.1108/JME-03-2016-0023
254. Tatalovic M (2009) Science comics as tools for science education and communication: A brief, exploratory study. J Sci Commun 8(4):02. https://doi.org/10.22323/2.08040202
255. de Wit MM (2020) Democratizing CRISPR? Stories, practices, and politics of science and governance on the agricultural gene editing frontier. Elem Sci Anth 8(1). https://doi.org/10.1525/elementa.405
256. Arcadias L et al (2021) Astro-animation-A case study of art and science education. arXiv preprint arXiv:2104.06215. https://doi.org/10.48550/arXiv.2104.06215
257. Bandelli A, Konijn EA (2013) Science centers and public participation: Methods, strategies, and barriers. Sci Commun 35(4):419–448. https://doi.org/10.1177/1075547012458910
258. Schmidt M, Meyer A, Cserer A (2015) The Bio: Fiction film festival: Sensing how a debate about synthetic biology might evolve. Public Underst Sci 24(5):619–635. https://doi.org/10.1177/0963662513503772
259. Various (2023) Grain & Noise – Artists in Synthetic Biology Labs. Constructive Disturbances of Art in Science. Germany Transcript Publisher, Bielefeld
260. World federation of occupational therapists. About occupational therapy. Available online: https://wfot.org/about/about-occupational-therapy. Accessed 1 Dec 2024
261. Speech-language and audiology Canada (SAC). Scope of practice for speech-language pathology. Available online: https://www.sac-oac.ca/wp-content/uploads/2023/01/scope_of_practice_speech-language_pathology_en-1.pdf. Accessed 1 Dec 2024
262. Canadian nurses association. Evidence-informed decision-making and nursing practice. Available online: https://hl-prod-ca-oc-download.s3-ca-central-1.amazonaws.com/CNA/2f975e7e-4a40-45ca-863c-5ebf0a138d5e/UploadedImages/documents/Evidence_informed_Decision_making_and_Nursing_Practice_position_statement_Dec_2018.pdf. Accessed 1 Dec 2024
263. Canadian nurses association. Advanced nursing practice. Available online: https://www.cna-aiic.ca/en/nursing-practice/the-practice-of-nursing/advanced-nursing-practice. Accessed 1 Dec 2024
264. Canadian nurses association. Nursing leadership. Available online: https://hl-prod-ca-oc-download.s3-ca-central-1.amazonaws.com/CNA/2f975e7e-4a40-45ca-863c-5ebf0a138d5e/UploadedImages/documents/Nursing_Leadership_position_statement.pdf. Accessed 1 Dec 2024
265. Canadian nurses association. Registered nurses, health and human rights. Available online: https://hl-prod-ca-oc-download.s3-ca-central-1.amazonaws.com/CNA/2f975e7e-4a40-45ca-863c-5ebf0a138d5e/UploadedImages/documents/Nurses_Health_and_Human_Rights_position_statement_Dec_2018.pdf. Accessed 1 Dec 2024
266. Stewart-Amidei C et al (2010) American association of neuroscience nurses scope and standards of practice for neuroscience advanced practice nurses. J Neurosci Nurs 42(3):E1–E8. https://doi.org/10.1097/JNN.0b013e3181d5bf14
267. Canadian association of social workers (CASW). Guidelines for the development of professional practice legislation. Available online: https://www.casw-acts.ca/sites/default/files/attachements/guidelines_for_development_of_professional_practice_final_may09.pdf. Accessed 1 Dec 2024
268. Canadian Association of Occupational Therpists (CAOT). Profile of practice of occupational therapists in Canada. Available online: https://www.caot.ca/document/3653/2012otprofile.pdf. Accessed 1 Dec 2024
269. Villamil V, Wolbring G (2019) Role and Scope coverage of speech-related professionals linked to neuro-advancements within the academic literature and canadian newspapers. Educ Sci 9(2):Article98. https://doi.org/10.3390/educsci9020098
270. Villamil V, Deloria R, Wolbring G (2019) Artificial intelligence and machine learning: What is the role of social workers, occupational therapists, audiologists, nurses and speech language pathologists according to academic literature and Canadian newspaper coverage? In: REHAB '19: 5th Workshop on ICTs for improving patients rehabilitation research techniques. ACM, Popayán, Colombia 11–13th September
271. Deloria R, Wolbring G (2019) Neuro-advancements and the role of nurses as stated in academic literature and Canadian newspapers. Societies 9(3):article61. https://doi.org/10.3390/soc9030061
272. Wolbring G, Diep L (2014) Engaging with technology governance in social work education: An essential for preparing future social work (ers). J Contin Soc Work Educ 17(2):63–75
273. Djebrouni M, Wolbring G (2021) Social workers as professionals and citizens: The case of governance of neuroscientific and neurotechnological advancements. Prof Dev Int J contin Soc Work Educ 23(2):22
274. Bell E et al (2016) Deep brain stimulation as clinical innovation: An ethical and organizational framework to sustain deliberations about psychiatric deep brain stimulation. Neurosurgery 79(1):3–10. https://doi.org/10.1227/NEU.0000000000001207
275. Vidmar T (2014) New dimensions of understanding of lifelong learning from antiquity to comenius. Rev Eur Stud 6(3):91. https://doi.org/10.5539/res.v6n3p91
276. Webster-Wright A (2009) Reframing professional development through understanding authentic professional learning. Rev Educ Res 79(2):702–739. https://doi.org/10.3102/0034654308330970
277. Knapper C, Cropley AJ (2000) Lifelong learning in higher education. Psychology Press
278. Medel-Anonuevo C, Ohsako T, Mauch W. Revisiting lifelong learning for the 21st century. Available online: https://unesdoc.unesco.org/ark:/48223/pf0000127667. Accessed 1 Dec 2024
279. Schuetze HG (2006) International concepts and agendas of lifelong learning. Comp J Comp Int Educ 36(3):289–306. https://doi.org/10.1080/03057920600872381
280. Canadian nurses association. Position statement: Promoting continuing competence for registered nurses. Available online: https://hl-prod-ca-oc-download.s3-ca-central-1.amazonaws.com/CNA/2f975e7e-4a40-45ca-863c-5ebf0a138d5e/UploadedImages/documents/Promoting_

Continuing_Competence_for_Registered_Nurses_position_statement.pdf. Accessed 1 Dec 2024
281. Gopee N (2005) Professional development. Facilitating the implementation of lifelong learning in nursing. Br J Nurs 14(14):761–767. https://doi.org/10.12968/bjon.2005.14.14.18553
282. Canadian Association of Social Workers. The Canadian association of social work's code of ethics Available online: https://www.casw-acts.ca/en/Code-of-Ethics%20and%20Scope%20of%20Practice. Accessed 1 Dec 2024
283. Canadian Association for Social Work Education. Standard for accreditation available online: http://caswe-acfts.ca/wp-content/uploads/2013/03/CASWE-ACFTS-Standards-11-2014.pdf. Accessed 1 Dec 2024
284. Canadian Association of Social Workers. Professional development. Available online: https://www.casw-acts.ca/en/continuing-education/professional-development. Accessed 1 Dec 2024
285. Compton MV, Tucker DA, Flynn PF (2009) Preparation and perceptions of speech-language pathologists working with children with cochlear implants. Commun Disord Q 30(3):142–154. https://doi.org/10.1177/1525740108325554
286. Xue L et al (2018) Defining interdisciplinary competencies for audiological rehabilitation: Findings from a modified Delphi study. Int J Audiol 57(2):81–90. https://doi.org/10.1080/14992027.2017.1406156
287. Ilott I, White E (2001) 2001 College of occupational therapists' research and development strategic vision and action plan. Br J Occup Ther 64(6):270–277. https://doi.org/10.1177/030802260106400602
288. College of Occupational Therapists Ontario. Code of ethics. Available online: https://www.coto.org/docs/default-source/PDFs/code-of-ethics---reformatted-may-2016.pdf?sfvrsn=8. Accessed 1 Dec 2024
289. Li Z (2017) Citizenship education 'goes global': Extracurricular learning in an overseas campus of a British civic university. Int J Lifelong Educ 36(6):662–678. https://doi.org/10.1080/02601370.2017.1375565
290. Field J, Schemmann M (2017) International organisations and the construction of the learning active citizen: An analysis of adult learning policy documents from a Durkheimian perspective. Int J Lifelong Educ 36(1–2):164–179. https://doi.org/10.1080/02601370.2017.1287920
291. Mikelatou A, Arvanitis E (2018) Social inclusion and active citizenship under the prism of neoliberalism: A critical analysis of the European Union's discourse of lifelong learning. Educ Philos Theor 50(5):499–509. https://doi.org/10.1080/00131857.2017.1382348
292. Lucio-Villegas E (2014) Basic skills for becoming a citizen. In: Challenging the'european area of lifelong learning'. Springer, p 41–50
293. Threats TT (2010) The ICF and speech-language pathology: Aspiring to a fuller realization of ethical and moral issues. Int J Speech-Lang Pathol 12(2):87–93. https://doi.org/10.3109/17549500903568476
294. Fejes A, Dahlstedt M (2012) The confessing society : Foucault, confession and practices of lifelong learning. Taylor & Francis Group, London, UNITED KINGDOM
295. Bessant J, Farthing R, Watts R (2016) Co-designing a civics curriculum: Young people, democratic deficit and political renewal in the EU. J Curr Stud 48(2):271–289. https://doi.org/10.1080/00220272.2015.1018329
296. Moss AU, Li ZR, Rommelfanger KS (2021) Assessing the perceived value of neuroethics questions and policy to neuro-entrepreneurs. Front Neurosci 15:702019. https://doi.org/10.3389/fnins.2021.702019
297. Salles A, Evers K, Farisco M (2019) Neuroethics and philosophy in responsible research and innovation: The case of the human brain project. Neuroethics 12(2):201–211. https://doi.org/10.1007/s12152-018-9372-9
298. Biofaction. Bio-Fiction. Available online: Accessed 1 Dec 2024
299. Grabham T. Paramusical Ensemble. Presented at Bio-Fiction Festival https://bio-fiction.com/films-2019/. Available online: https://bio-fiction.com/films-2019/. Accessed 1 Dec 2024
300. Plasman F. The auxiliary. Presented at Bio-Fiction Festival https://bio-fiction.com/films-2019/. Available online: https://bio-fiction.com/films-2019/. Accessed 1 Dec 2024
301. Thutat Ungur A. Reboot.Presented at Bio-Fiction Festival https://bio-fiction.com/films-2019/. Available online: https://bio-fiction.com/films-2019/. Accessed 1 Dec 2024
302. Riedl V, Schuld F. Carlotta's face. Presented at Bio-Fiction Festival https://bio-fiction.com/films-2019/. Available online: https://bio-fiction.com/films-2019/. Accessed 1 Dec 2024
303. Alonso-Berbel V. Perfectly Natural. Presented at Bio-Fiction Festival. Available online: https://bio-fiction.com/films-2019/. Accessed 1 Dec 2024
304. Kuder S, Adam & Eve Mk II. Presented at Bio-Fiction Festival. https://bio-fiction.com/films-2019/. Available online: https://bio-fiction.com/films-2019/. Accessed 1 Dec 2024
305. Gelamdin RB, Alias N, Attaran M (2013) Students' and teachers' perspectives on biotechnology education: A review on publications in selected journals. Life Sci J 10(1):1210–1221. https://www.researchgate.net/publication/286796794_Students'_And_Teachers'_Perspectives_On_Biotechnology_Education_A_Review_On_Publications_In_Selected_Journals
306. Gill PS (2015) Genetic superheroes and socioscientific issues in science education. Nat Teacher Educ J 8(3):67–68
307. Lillywhite A, Wolbring G (2022) Undergraduate disabled students as knowledge producers including researchers: Perspectives of disabled students. Educ Sci 12(2):article number 77. https://doi.org/10.3390/educsci12020077
308. Nielsen GB (2019) Capitalism, political participation and the Student as a revolutionary figure. In: enacting the university: Danish university reform in an ethnographic perspective. Springer Netherlands, Dordrecht, p 261–84. https://doi.org/10.1007/978-94-024-1921-4_10
309. Kreitlow A et al (2021) Support for global health and pandemic preparedness in medical education in Germany: Students as change agents. Int J Health Plann Manage 36:112-123. https://doi.org/10.1002/hpm.3143
310. Kehoe I (2015) The cost of performance? Students' learning about acting as change agents in their schools.

Discourse 36(1):106–119. https://doi.org/10.1080/01596306.2013.841356
311. Vogel AL. Fichtenberg C, Levin MB (2010) Students as change agents in the engagement movement. In: Handbook of Engaged Scholarship. p 369–389
312. Harper D (2003) Students as change agents: The generation Y model. In: Technology-Rich Learning Environments: A Future Perspective. p 307–30. https://doi.org/10.1142/9789812564412_0014
313. Kiehl EM, Wink DM (2000) Nursing students as change agents and problem solvers in the community: Community-based nursing education in practice. Nurs Health Care Perspect 21(6):293–297
314. Dollinger M, Mercer-Mapstone L (2019) What's in a name? Unpacking students' roles in higher education through neoliberal and social justice lenses. Teach Learn Inq 7(2):73–89. https://doi.org/10.20343/teachlearninqu.7.2.5
315. Bell A (2016) Students as co-inquirers in Australian higher education: Opportunities and challenges. Teach Learn Inq 4(2). https://doi.org/10.20343/teachlearninqu.4.2.8
316. Annette J (2009) Active learning for active citizenship' Democratic citizenship and lifelong learning. Educ Citiz Soc Justice 4(2):149–160. https://doi.org/10.1177/1746197909103934
317. Wolbring G (2012) Citizenship education through an ability expectation and "Ableism" Lens: The challenge of science and technology and disabled people. Educ Sci 2(3):150–164. https://doi.org/10.3390/educsci2030150
318. Maass K et al (2022) Promoting active citizenship in mathematics and science teaching. Int J Sci Math Educ 20(4):727–746. https://doi.org/10.1007/s10763-021-10182-1
319. Egan-Simon D (2022) Active agents of change: A conceptual framework for social justice-orientated citizenship education. Equity Educ Soc 27526461221089350. https://doi.org/10.1177/27526461221089350
320. Hayik R (2020) Through their lenses: Arab students' environmental documentation and action. Environ Educ Res 27(3):438–461. https://doi.org/10.1080/13504622.2020.1860197
321. Warwick P (2016) An integrated leadership model for leading education for sustainability in higher education and the vital role of students as change agents. Manage Educ 30(3):105–111. https://doi.org/10.1177/0892020616653463
322. Willmore C (2016) Student capital in green cities: Building university—student—city coalitions. In: World Sustainability Series. p 301–315
323. Waddock S (2020) Thinking transformational system change. J Change Manage 20(3):189–201. https://doi.org/10.1080/14697017.2020.1737179
324. Nordin AMM, Andersson Gäre B, Andersson AC (2018) Sensemaking and cognitive shifts – learning from dissemination of a National Quality Register in health care and elderly care. Leadersh Health Serv 31(4):371–383. https://doi.org/10.1108/LHS-03-2017-0013
325. Nathani N, Mathur G, Dwivedi G (2019) Social responsibility and academic achievement: A perceptual learning. Int J Inn Technol Exploring Eng 9(1):5221–5226. https://doi.org/10.35940/ijitee.A9235.119119
326. Tran LT, Vu TTP (2017) 'Responsibility in mobility': International students and social responsibility. Glob Soc Educ 15(5):561–575. https://doi.org/10.1080/14767724.2016.1195729
327. Tucker DA, Hendy J, Barlow J (2015) The importance of role sending in the sensemaking of change agent roles. J Health Organ Manage 29(7):1047–1064. https://doi.org/10.1108/JHOM-12-2013-0279
328. Braun V, Clarke V (2013) Successful qualitative research: A practical guide for beginners. Sage, Thousand Oaks
329. Clarke V, Braun V (2014) Thematic analysis. In: Teo T (ed) Encyclopedia of critical psychology. Springer, New York, p 1947–1952
330. Odorico S (2020) Beyond the screen: Interactive documentary exhibition in the festival sphere. In: Vallejo A, Winton E (eds) Documentary Film Festivals Vol. 2: Changes, Challenges, Professional Perspectives. Springer International Publishing, Cham, p 93–111. https://doi.org/10.1007/978-3-030-17324-1_6
331. Kerbe W, Khodhzaeva A, SM. Using short films for public engagement with synthetic biology. Available online: https://www.biofaction.com/wp-content/uploads/2012/04/short_films_public_engagement-2.pdf. Accessed 1 Dec 2024
332. OECD. Understanding the brain: Towards a new learning science. Available online: https://www.oecd-ilibrary.org/education/understanding-the-brain_9789264174986-en. Accessed 1 Dec 2024
333. OECD's Centre for educational research and innovation (CERI). Learning sciences and brain research. Available online: http://www.oecd.org/education/ceri/brainandlearningprojectbackground.htm. Accessed 1 Dec 2024
334. Appeldorn C (1988) Continuing education in neuroscience nursing. J Neurosci Nurs 20(2):73–78. https://doi.org/10.1097/01376517-198804000-00002
335. Hardiman M et al (2012) Neuroethics, neuroeducation, and classroom teaching: Where the brain sciences meet pedagogy. Neuroethics 5(2):135–143. https://doi.org/10.1007/s12152-011-9116-6
336. Deloria R et al (2019) How research literature and media cover the role and image of disabled people in relation to artificial intelligence and neuro-research. Eubios J Asian Int Bioeth (EJAIB) 29(5):169–182
337. Oxford English Dictionary (n.d.) transhumanism, n. Oxford University Press
338. Wolbring G (2012) Expanding ableism: Taking down the ghettoization of impact of disability studies scholars. Societies 2(3):75–83. https://doi.org/10.3390/soc2030075
339. Wolbring G (2008) The politics of ableism. Development 51(2):252–258. https://doi.org/10.1057/dev.2008.17
340. Wolbring G (2008) Is there an end to out-able? Is there an end to the rat race for abilities? J Media Cult 11(3). https://doi.org/10.5204/mcj.57
341. Teunisse W, Youssef S, Schmidt M (2019) Human enhancement through the lens of experimental and speculative neurotechnologies. Hum Behav Emerg Technol 1(4):361–372. https://doi.org/10.1002/hbe2.179

342. Djebrouni M, Wolbring G (2020) Impact of robotics and human enhancement on occupation: What does it mean for rehabilitation? Disab Rehab 42(11):1518–1528. https://doi.org/10.1080/09638288.2018.1527401
343. Wolbring G (2016) Employment, disabled people and robots: What is the narrative in the academic literature and Canadian newspapers? Societies 6(2):Article 15. https://doi.org/10.3390/soc6020015
344. Kaipainen K, Ahtinen A, Hiltunen A (2018) Nice surprise, more present than a machine: Experiences evoked by a social robot for guidance and edutainment at a city service point. In: Proceedings of the 22nd International Academic Mindtrek Conference. Association for Computing Machinery, Tampere, Finland. https://doi.org/10.1145/3275116.3275137
345. Ott I (2012) Service robotics: An emergent technology field at the interface between industry and services. Poiesis Prax 9(3-4):219-229. https://doi.org/10.1007/s10202-012-0110-9
346. Wolbring G, Nasir L (2024) Intersectionality of disabled people through a disability studies, ability-based studies, and intersectional pedagogy lens: A Survey and a Scoping Review. Societies 14(9):176. https://doi.org/10.3390/soc14090176