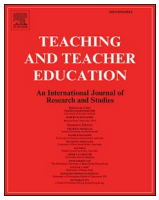
Teaching and Teacher Education 143 (2024) 104545

Contents lists available at ScienceDirect

Teaching and Teacher Education

journal homepage: www.elsevier.com/locate/tate



Research paper

Improving queer history knowledge and perspective-taking toward LGBTQ+ people: There's an app for that

Jason M. Harley [a,b,c,d,*], Nigel Mantou Lou [b,e], Byunghoon "Tony" Ahn [a], Yang S. Liu [d,f]

[a] Department of Surgery, Faculty of Medicine and Health Sciences, McGill University, Montreal, QC, Canada
[b] Research Institute of the McGill University Health Centre, Montreal, QC, Canada
[c] Institute for Health Sciences Education, McGill University, Montreal, QC, Canada
[d] Department of Educational Psychology, University of Alberta, Edmonton, AB, Canada
[e] Department of Psychology, University of Victoria, Victoria, BC, Canada
[f] Department of Psychiatry, University of Alberta, Edmonton, AB, Canada

ARTICLE INFO

Keywords:
App
Empathy
LGBTQ
Perspective-taking
Queer history

ABSTRACT

Minority history education can support perspective-taking which is linked to decreasing stereotypes and prejudice. A pre-test post-test randomized control trial study with 114 pre-service teachers was conducted to examine the role of queer history instruction to improve learners' self-reported perspective-taking toward LGBTQ + minorities and knowledge of queer history. Participants in the Edmonton Queer History App (vs. control) condition learned significantly more and reported higher levels of perspective-taking towards both sexual orientation (SO) and gender identity (GI) minority members. Mediation analysis showed that learning outcome explained the effect of the app condition on the increase of perspective-taking towards SO (but not GI).

1. Introduction

While many social studies and history curriculums aim to help students broaden their understanding of how societies have changed and the importance of these changes, queer history is often absent in formal curriculums despite important developments over the last decades in LGBTQ + rights. LGBTQ + people collectively represent a small percentage of people, accounting for only 4% of the total population in Canada according to data from a 2018 federal study (Statistics Canada, 2021a). Therefore, individuals have fewer opportunities to enhance knowledge about LGBTQ + people than many other minority groups through both formal education as well as intergroup contact (Pettigrew & Tropp, 2008; Statistics Canada, 2022b). This is an important gap to address because both intergroup contact and history education stand to contribute to the development of empathy (Bartelds et al., 2020; Pettigrew & Tropp, 2008). Empathy, in turn, is linked to decreasing stereotypes and prejudice toward minority groups (Galinsky et al., 2005; Galinsky & Moskowitz, 2000; Mashuri et al., 2017).

Given the continued over-representation of LGBTQ + individuals in violent hate crimes and other incidents of prejudice (Nadal, 2019; Statistics Canada, 2021b; US Department of United States Department of Justice, 2020) action is needed. In American Educational Research Association, 2021 issued a statement that educators have a responsibility to support sexual orientation (SO) and gender identity (GI) minority students and eradicate homophobic and transphobic cultures and practices that can undermine and harm SO and GI students' and educators' life (American Educational Research Association, 2021). This statement drew attention to the reality that environments where the status quo of cisheteronormativity is not challenged are likely to fail to meaningfully improve the toxic and often dangerous conditions LGBTQ + people find themselves in (Peter, 2021; Kosciw et al., 2022). For example, a recent EGALE Climate Survey on Canadian schools reported that 48% of LGBTQ + students felt unsafe at school, compared to only 4% of cisgender heterosexual students (Peter et al., 2021). Overall, LGBTQ + students experience more significant verbal harassment and bullying than cisgender heterosexual students regarding their sexual orientation, gender identity, and gender expression (Peter et al., 2021; Di Stasio et al., 2023).

School-based initiatives and programs are important for overcoming the challenges experienced by LGBTQ + students. Gay-Straight Alliance (GSA) clubs, also called Gender and Sexuality Alliance, are common LGBTQ2 school-based supports which has seen an increase across North

* Corresponding author. Department of Surgery, Faculty of Medicine and Health Sciences, McGill University, Montreal General Hospital, 1650 Cedar Ave, R1 Montreal, QC, H3G 1A4, Canada.
E-mail address: jason.harley@mcgill.ca (J.M. Harley).

https://doi.org/10.1016/j.tate.2024.104545
Received 27 April 2023; Received in revised form 19 January 2024; Accepted 22 February 2024
Available online 11 March 2024

America over the last decade (Peter et al., 2021). Qualitative research involving LGBTQ + student perspectives has demonstrated that GSAs positively influence the physical, social, emotional, and academic well-being of LGBTQ + youth and allies (Porta et al., 2017). Fetner and Elafros (2015) found that LGBTQ + students had more support from teachers and administrators in schools with GSAs than in schools without GSAs. Di Stasio et al. (2023) found that students who were aware of their school's GSA club scored higher on the self-determination subscales regarding family relationships and lower on bullying compared to students who were unaware of their school's GSA club.

The most prominent initiatives that target teacher education involve including LGBTQ + -themed texts and using queer theory (Airton & Koecher, 2019). Staley and Blackburn (2023) designed and examined a course employing such pedagogical strategies and found that "queering" pre-service teacher education posed challenges, such as emotional discomfort, as well as promise. Educational interventions to teach queer history contribute to combatting what Staley and Blackburn (2023) describe as a "discourse of silence surrounding gender and sexuality diversity" (p.1). Research on queer history education is scarce, however, while the opportunities and advantages are many. In this study we focused on examining the effectiveness of a queer history app to enhance pre-service teachers' knowledge of queer history and perspective-taking toward LGBTQ + people as pre-service teachers are one of the key populations of interest and one we could conduct a randomized control trial with."

1.1. Queer history education

History education (and its reform) are an important component of cultivating equity, diversity and inclusion (EDI), through truth telling, official acknowledgement of victims, the harm inflicted towards them, and their memories (Cole, 2007; Einfeld & Collins, 2008; Gachago et al., 2014; Rios et al., 2003). Education on minorities' struggles and achievements can improve people's attitudes toward social justice and movements that aim to reduce minority-majority disparities (Verkuyten & Thijs, 2013). Education on the history of vulnerable minority groups and their struggles stands to promote 21st Century competencies such as communicating and collaborating with diverse stakeholders and colleagues (Qian & Clark, 2016; Trilling & Fadel, 2009), a skill also referred to as cultural competence (Clark, 2010; Margolies & Brown, 2019).

An understanding of diverse populations, including their history and experiences, is a critical component in preparing pre-service teachers' cultural diversity competency (Virta, 2009) and may help shrink gaps between teachers' beliefs, perceptions, and practices concerning LGBTQ + -inclusive education (Taylor et al., 2016). To supplement current curriculums, existing programs such as immersion programs and diversity training are shown to increase pre-service teachers' positive attitudes toward vulnerable populations (Malewski et al., 2012; Wiggins et al., 2007).

Therefore, it is pertinent to generate more educational opportunities for students and pre-teachers, to support expanding their scope of understanding around diverse populations, and more specifically, the LGBTQ + population. Our app, the Edmonton Queer History (EQH) App, and associated program of research stands to help address this mandate while contributing to an area of research, in addition to education, that has received scant attention: the intersection of social/historical justice and history education (Keynes et al., 2021). Indeed, to the best of our knowledge, there has been scant research promoting and examining the history, culture, or general social issues of minority groups (e.g., Asian history: Hwang et al., 2013; Islamophobia: Lentin & Humphry, 2017).

Further, there has been a critical call for more thoughtful integrations of educational technology that foster equity, diversity, and inclusion (Papendieck, 2018). We were only able to locate a small number of recent studies that examined or, more commonly, reviewed or discussed educational technologies, including apps (Ahn & Harley, 2020 Harley et al., 2019, Harley et al., 2020a), video games (Ruberg, 2018; Ruberg et al., 2018), virtual reality and augmented reality (Ceuterick, 2021), and computer-mediated communication platforms (Alix, 2020) to support LGBTQ + history. Previous empirical literature include a study by Harley et al. (2019, Harley, Lajoie, Tressel, & Jarrell, 2020b) that employed a pretest-post-test design and found that an educational app was associated with increased knowledge and empathy. Further, technology-related enjoyment significantly predicted learners' perceived success in learning queer history (Harley et al., 2019). Our search did not yield any previous research that employed a randomized control approach to study queer history learning with educational technology. Furthermore, reviews of studies that used educational technologies to examine learning revealed that the majority of scholarship that did target general history education focused on events rather than on topics of equity, diversity, and inclusion in education or the histories of underrepresented groups (Crompton et al., 2017; Liu et al., 2014; Mohamed & Al-Hidabi, 2019). Accordingly, our study addresses gaps in both minority history educational content and educational research while responding to calls to leverage the opportunities educational technology offers to do so.

1.2. Perspective-taking

Perspective-taking is the cognitive aspect of empathy and is defined as the ability to engage in thinking about and understanding others' thoughts and experiences (Keating, 1990). Like Wang et al. (2003), we advocate building an understanding of group-specific perspective-taking because general perspective-taking tendencies do not necessarily apply equally to all groups, particularly, when individuals have little knowledge of and/or may have biases for seeing groups as lesser than themselves. For example, Wang et al. (2003) found that non-Caucasian students reported more understanding of the experience of other ethnocultural groups by taking their perspective than Caucasian students.

Perspective-taking is an important ability that is linked to decreasing stereotypes and prejudice toward minority groups and argued to be key to social cohesion (Galinsky et al., 2005; Galinsky & Moskowitz, 2000; Mashuri et al., 2017). Specifically, perspective-taking has been found to be an effective factor to combat different types of prejudice, such as racism, homophobia, and transphobia (e.g., Broockman & Kalla, 2016; DeBerry et al., 2023; Todd et al., 2011, 2012). Unfortunately, LGBTQ + perspective-taking interventions are rare (DeBerry et al., 2023).

We propose that learning about history may help students build perspective-taking skills (Warren, 2018) toward LGBTQ + people. Though this is an understudied area, there is some evidence from one preliminary study using a correlational design (Harley et al., 2020a) and studies with younger populations to support such aims (Gehlbach et al., 2012; McVee, 2014; Rios et al., 2003). For example, fostering fifth-grade students' perspective-taking supported their ability to develop personal connections with history as well as understand different historical viewpoints (Dulberg, 2002). Furthermore, research has found that adolescent-aged students who were more skilled at historical perspective-taking demonstrated proficient use of various historical reasoning strategies such as employing historical empathy and reconstructing historical contexts (Huijgen et al., 2017). Moreover, research has shown that perspective-taking can be manifested through interactive learning with educational technologies, including augmented reality (AR; Efstathiou et al., 2018; Lindgren, 2012; Roberts et al., 2014; Herrera et al., 2018). For example, research has shown that an AR museum exhibit that allowed learners to have interactive control can positively affect learners' perspective taking (Roberts et al., 2014).

2. Research questions and hypothesis

The goals of this study were to understand whether learning about LGBTQ + history with the EQH App (vs. a commercial video game app control condition) enhanced pre-service teachers' (henceforth referred to as learners'): (1) perspective-taking toward sexual orientation (SO)

and gender identity GI minorities and (2) knowledge of queer history. Specifically, we investigated two research questions:

(RQ1a) Did students randomly assigned to the EQH app LGBTQ + history condition (henceforth referred to as the EQH app condition) report a statistically significant increase in perspective-taking toward SO and GI minorities after using the EQH app? (RQ1b) did students randomly assigned to the EQH app condition report significantly higher levels of perspective-taking than those assigned to the control app condition? (RQ1c) Did students' increase in knowledge of queer history mediate the effect of condition on their increase in perspective-taking? We hypothesized that students randomly assigned to the EQH app condition would have a statistically significantly higher increase in perspective-taking than those assigned to the control app condition. We hypothesized that the effect of the EQH app on increases in perspective-taking would be mediated by learning (i.e., increase in knowledge).

(RQ2a) Did students randomly assigned to the EQH app condition have a statistically significant increase in knowledge about queer history after using the EQH app? (RQ2b) Did students randomly assigned to the EQH app condition learn statistically significantly more than those assigned to the control app condition? We hypothesized that students randomly assigned to the EQH app condition would increase their queer history knowledge and learn statistically significantly more than those assigned to the control condition.

3. Method

3.1. Study design

A pre-test post-test randomized control trial study was conducted to examine the role of queer history instruction to improve learners' self-reported perspective-taking toward LGBTQ + minorities and knowledge of queer history.

3.2. Participants

Data were collected from 114 undergraduate students enrolled in a pre-service teacher program from a North American university. Of the 114 participants, 76 identified as female, 36 as male, and two identified as being GI minorities (e.g., non-binary). Further, 101 identified as heterosexual whereas 13 identified as SO minorities (e.g., lesbian). 75 participants identified as white while 39 identified as racial minorities. Participants' ages were between 18 and 41 years old ($M = 23.69$, $SD = 4.86$).

Institutional ethics board approval was obtained. Participants' data was anonymized through the use of participant numbers assigned by the experimenters. Participants were recruited through a departmental subject pool program that provided pre-service teachers with course credit. Participation was voluntary. Our study was one of several studies participants could elect to participate in and they were also offered the option to conduct an alternative assignment for the same course credit (e.g., reviewing and responding to questions about a research article).

A retrospective power analysis revealed that our sample of 114 had sufficient power for the analyses we conducted. Specifically, a power analysis was conducted using G*Power version 3.1.9.7 (Faul et al., 2007) to calculate the power of this study. In our calculation, we used a smaller effect size (0.15) using Cohen's (1988) criteria that was more conservative in nature. In addition, we had a β/α ratio of 0.5, a correlation among repeated measures of 0.25, and a sample of one-hundred and fourteen participants ($N = 114$) separated into two groups, with 4 measurements as part of the within-between design. These produced an estimated power of 0.94, which is large enough to support the analysis's claims.

As we briefly discussed in the literature, pre-service teachers are a particularly important group of learners as professionals charged with educating a diverse student body and whom are also in a position to use the app as a supplemental resource not only to advance their own learning, but their students'. Indeed, a high school social studies and history professor showed us the limited representation of queer people in the current curriculum in the two textbooks used at the time in the Canadian province (i.e., Alberta) the app was developed in. These included: (1) an optional reading or activity and (2) inclusion of LGBTQ + people in the list of concentration camp victims (see also Harley et al., 2019). Our app therefore offers pre-service teachers a rare educational resource to address gaps in their own and their students' historical knowledge. Pre-service teachers were also an excellent population for our study because randomization would not be possible with high school students and a quasi-experimental study would not have provided the evidence we sought at this phase in our program of research.

3.3. Procedure

The study took approximately 2 h and involved participants filling out a consent form, completing a pre-test survey, interacting with the EQH app (experimental condition; $n = 57$) or game app (control condition; $n = 57$), depending on random assignment, and finally completing a post-test survey. Prior to completing the pre-test survey participants were asked to review a glossary of LGBTQ + terms and informed that the glossary would remain available to them to consult throughout the study and completion of the surveys. Participants in the EQH app also has access to the glossary through the app. Participants in both conditions were introduced to the app prior to use (see Appendix A). The EQH app participants were further instructed to watch a tutorial video and read a summary page about the app. The EQH app participants were then asked to let the experimenter know when they had completed the virtual tour. While the tutorial video encouraged participants to go through the virtual tour locations in the order they were presented, they were able to deviate from the order (though non did) as well as return to locations they have visited if they wanted to.

All of the EQH app participants viewed all eight vignettes on the app and interacted with all of the various media available on them (e.g., photo galleries, audio interviews, videos, etc.). The learners from the EQH app condition spent an average of 35-min and 57-sec (SD: 8-min and 40-sec) on the app with a range of 12-min 41-sec and a maximum of 56-min and 40-sec. The experimenter remained in the room to answer any questions the participant might have, ensure no technical difficulties occurred (none did) and to unobtrusively monitor off-task behaviour (none was observed).

Prior to data collection, we anticipated that participants in the app condition would take approximately 30 min to go through our EQH app based on participants from the previous study and piloting. Accordingly, we allotted 30 min for participants in the control condition to interact with the control app. We used time rather than an event as the criteria to end the session as there were no particular objectives associated with participants interacting with the control app; only the experimental need to have them interact with an app for roughly the same amount of time in between pre and post-test surveys (i.e., a distractor task). Given the fixed time, all participants in the control condition interacted for 30-min with the control app. There were no additional tutorial videos provided from us, although the game app featured an interactive tutorial at the very start of launching the app. All participants were actively engaged and made progress in the game's level during the control app sessions.

Surveys investigated participants' knowledge of queer history and perspective-taking toward SO and GI minorities pre- and post-EQH app or game app interaction. Recruitment materials did not mention the historical content of the app. Task instructions from the experimental protocol read to participants directly below can be found in Appendix A.

3.4. The Edmonton Queer History App

We developed an app to teach people about queer history because these technologies can include different types of historical media, such

as videos, audio, and GPS coordinates can be integrated into them to support historical contextualization and a more personal connection with historical actors, places, and events (Bartelds, et al., 2020). Further, such apps as can be adopted into varying teaching contexts, including pre-service teacher training, formal high school curriculums, and informal continuing education, without imposing costs to teachers or learners if the app is free (as ours is). Freely available and empirically tested educational resources represent a potential solution to supplement curriculums to improve students' knowledge and skills (Naylor & Gibbs, 2018; Van Laar et al., 2017). The EQH app ; Harley, 2018 was developed using the free content management system izi.TRAVEL (izi.TRAVEL. Mobile App Content Management System, 2011). We selected izi.TRAVEL because of its similarity to other mobile app platforms we have worked with and found to effectively foster emotional engagement and history knowledge (Harley, Lajoie, Tressel, & Jarrell, 2020b; Harley, Poitras, Jarrell, Duffy, & Lajoie, 2016; Poitras, Harley, & Liu, 2019). This content management system also allows for cross-platform and device use and for apps like ours to be available through both web browser (see (Harley, 2018) and acknowledgments section for link) and through the izi.TRAVEL app (available in major app stores). Using a content management system allowed us to focus on collecting, organizing, and presenting varied historical content and media, which we describe below, rather than the myriad of technical (e.g., programming) and other tasks creating an app from scratch entails. Additionally, using an established content management system helps support security and stability, such as software updates.

The EQH app includes eight historical locations in the city of Edmonton, Alberta, that showcase the challenges that the LGBTQ + community experienced and highlight the different ways in which events and places can serve as catalysts for change. The selected locations and associated multimedia vignettes (pictures, audio, video, and text from interviews and archival research) provide rich historical contextualization, particularly through the communication of a social frame of reference (van Drie & van Boxtel, 2008) that interweaves powerful personal as well as factual historical information, especially socio-political and cultural conditions of life (Haldane et al., 2023). Learners were able (and encouraged) to explore virtual 3D maps (via Google Street View) to compare and contrast how the past locations have transformed.

The EQH app was developed to be used on desktops, laptops, and mobile devices, such as smartphones and is compatible with both Microsoft Windows and Mac OS. Participants interacted with a desktop version of the cross-platform-compatible EQH app on a desktop computer that emulated mobile functionality, in part, through a touch screen monitor. Learners were invited to browse through the content of the app illustrated in Figs. 1 and 2 for the duration of the time of the time allotted to them.

We took a constructivist approach to designing the EQH App (see Harley et al., 2020a) by emphasizing factors that contribute to the learners' active experiences: the learner and their environment (Ertmer & Newby, 2013). We aimed to provide authentic contexts for our learners who attended university within the city the EQH App focuses on, for example. Moreover, the highlighted historical events are directly relevant to current day ones (e.g., pride parades) and controversies (e.g., gay-straight alliances in schools). These design decisions are also aligned with frameworks for supporting historical empathy. As mentioned above, historical contextualization was supported through providing a social frame of reference, while a personal connection was fostered by situating historical events at local landmarks and drawing connections between past and present struggles (Bartelds et al., 2020).

Our use of multimedia also aligns with other recommendations for teaching historical empathy, including using oral history interviews,

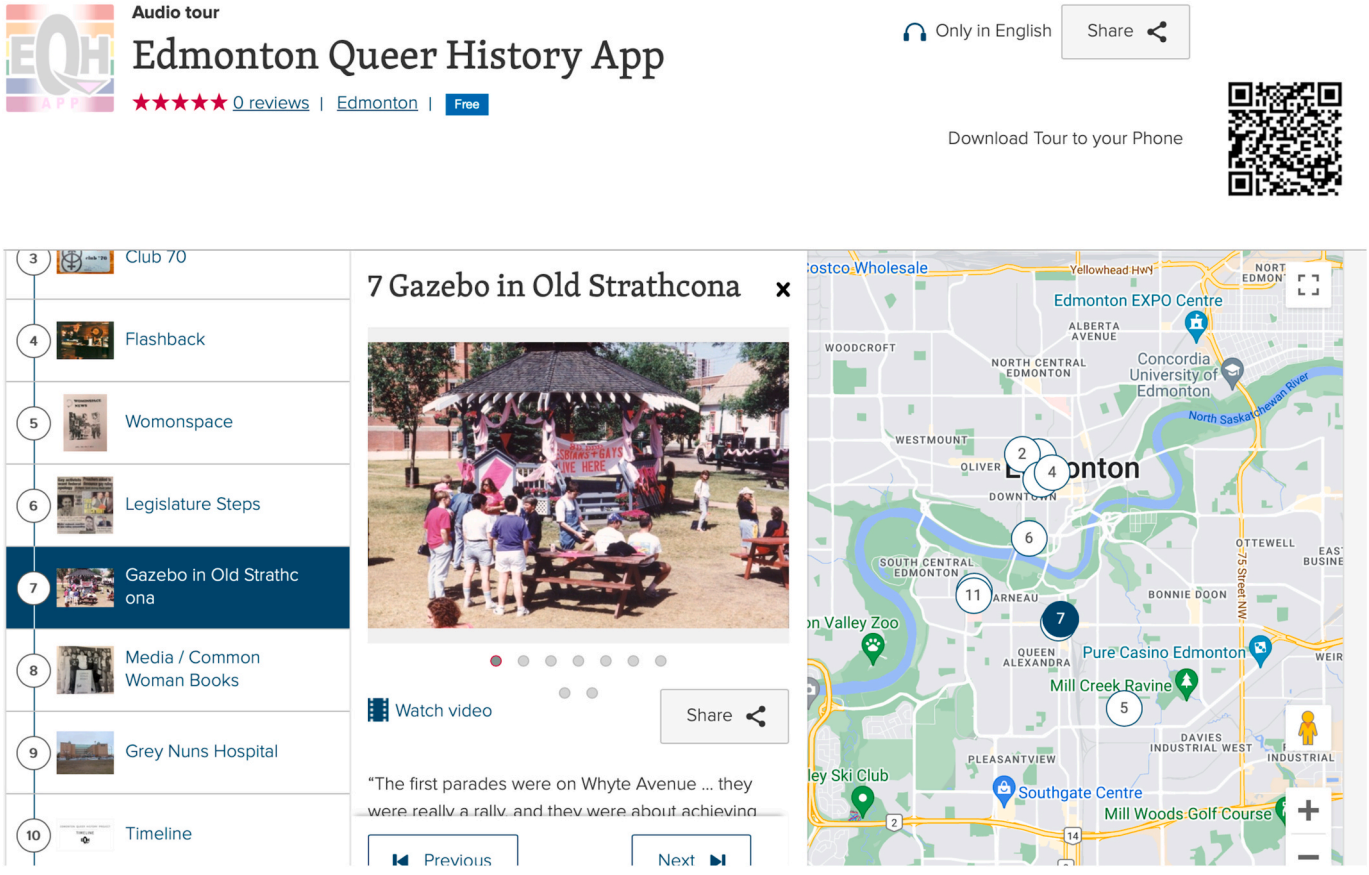


Fig. 1. Screenshot of the Queer History App Interface
Note. Blinded/pixelated for anonymous review.

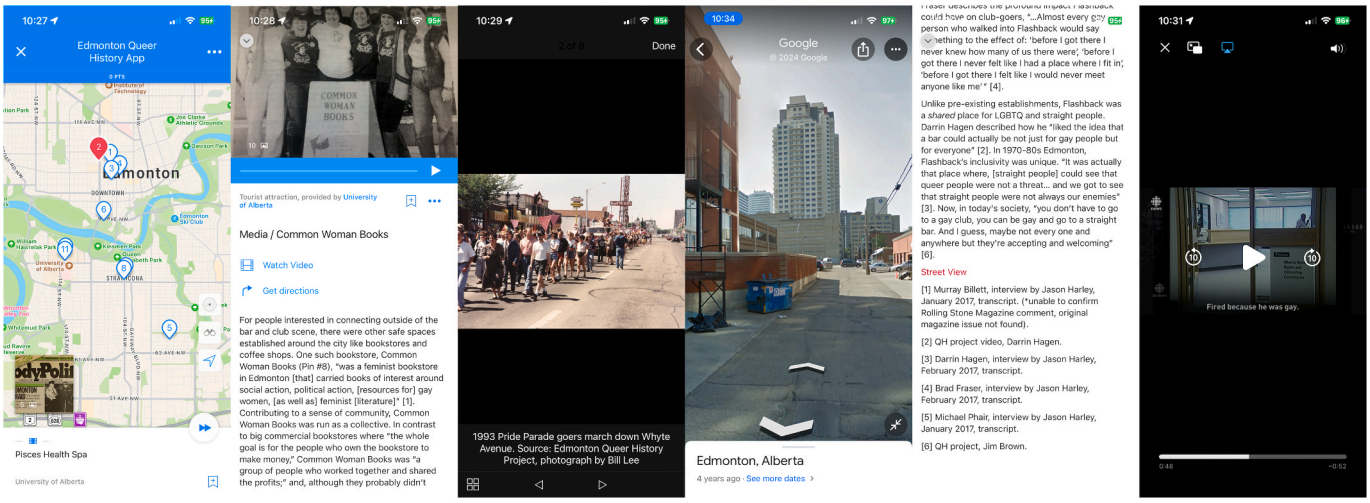


Fig. 2. Screenshot of Different Queer History App Interfaces Corresponding to Different Features
Note. (a) GPS-historical site interface, (b) historical site home page interface, (c) image and caption interface, (d) street interface, I narrative text interface, and (f) video interface.

visits to historical sites, video documentaries, and different primary and secondary sources (Bartelds et al., 2020; Foster, 1999). Audio and text extracts from interviews the first author conducted with prominent LGBTQ + elders provided a valuable primary and oral history source that was complimented with Canadian media and other historical sources. Through different multimedia as well as historical sources, we sought to provide learners with opportunities to construct knowledge on how the historical events, locations, and community transformed LGBTQ + rights.

Many of our design principles were also rooted in creating an app that learners would be motivated to use and find emotionally engaging. For example, the EQH App provides user-directed navigation, including providing choices concerning what learners paid attention to, for how long, and in what order. Such affordances can enhance learners' perceptions of control by supporting autonomy, pacing, and self-directed inquiry. For example, a learner could elect to look at historical pictures of a historical location, then compare it to the present day using the integrated Google Maps interface before reading the associated text-based vignette that describes its significance. They could choose to conclude their 'visit' to that space by listening to a clip of an audio interview, browsing through historical photos with captions or watching a historical video. Or perhaps something they read, heard, or saw prompted them to go back and revisit some of the mixed media from that location, compare it with another, or prompted them to review a LGBTQ + term they weren't familiar with in the integrated glossary. We also sought to leverage learners' previous experiences using similar and familiar technologies (e.g., the app was powered with Google Maps) and accommodate different levels of familiarity with LGBTQ + terms (e.g., transgender, lesbian) used in the app with a glossary they had access to throughout the study.

Collectively, these and other features and design decisions sought to foster desirable emotions (e.g., enjoyment, curiosity) and mitigate undesirable emotions (e.g., boredom, frustration) by enhancing perceptions of control and value (Pekrun, 2006, 2018). Fostering positive emotions is consistent with recent extensions of multimedia learning theory by Plass and Kaplan (2016) to Mayer (2005, 2019), which posit that incorporating emotionally and motivationally appealing design features (e.g., attractive content, graphics) can help to increase cognitive engagement and retain learners' attention. A previous pre-post-test study revealed that learners reported high levels of enjoyment, low levels of boredom, and a high usability score that suggested learners felt in excellent control over the technology (Harley et al., 2019). These emotions were also directed toward interacting with the app, specifically, which help differentiate how participants felt about using the app vs. learning about the content (topic emotions; also measured). See Harley et al. (2019, Harley, Lajoie, Tressel, & Jarrell, 2020b) for more details on the instructional design principles behind the development of the EQH App.

3.5. Commercial app game (control condition)

Participants in the control condition played the Plants vs. Zombies™ (Popcap Games n.d.) game which involved students learning about the functions of different fictional plants to defend against zombies (i.e., the gameplay mechanics). We selected Plants vs. Zombies as our control condition app because it was free, well-rated, and possible to learn to play quickly. The latter considerations were important as participants only had 30 min and we wanted to avoid frustrating them with a game that would either be frustratingly difficult or unpleasant to play for a short period of time. Indeed, Plants vs. Zombies™ is one of the most downloaded mobile games (Kim, 2013) and research has found that this game is enjoyable and elicits positive emotions among adults (Chesham et al., 2017; Johannes, Vuorre, & Przybylski, 2020; Merikivi et al., 2017) as well as children (Shute et al., 2016).

3.6. Instruments and measures

3.6.1. Queer history knowledge test

Historical knowledge was assessed using two counterbalanced tests of equivalent difficulty and length (14 items) that drew on items from a previously used 28-item multiple-choice test (Harley et al., 2019) Each question (except for one true-or-false question) contained four foils (i.e., options) and was designed to assess learners' knowledge of Edmonton queer history covered in the app (see Appendix B for examples). Participants were randomly assigned to receive a different, but equivalent set of 14 questions in the pre-test and post-test. In other words: all participants took two tests, but participants randomly assigned to test version A answered a set of 14 items as a pre-test and a different set of 14 different items as a post-test while participants assigned to test version B answered the same sets of 14 items but in the reserve order. The topics and difficulty of the 28 test items were divided and balanced using Papenberg's (2018) minDiff R-package.

3.6.2. Perspective-taking survey

Perspective-taking toward (a) sexual orientation (SO; e.g., lesbian) and (b) gender identity (GI; e.g., trans and non-binary) minorities were

assessed pre and post EQH app interaction using a modified version of the 7-item perspective-taking scale from the ethnocultural empathy scale (Wang et al., 2003; see Appendix C and D for examples). The questionnaire used a 6-point scale where 1 corresponded to "strongly disagree that it describes me," and 6 corresponded to "strongly agree that it describes me." Cronbach's Alpha indicated that total-scale internal consistency was good to better, αs ranging from 0.72 to 0.92 for pre-test and post-test for perspective-taking toward SO and GI minorities. Thirteen participants who identified as SO/GI were excluded from analyses to measure out-group perspective-taking (i.e., perspective-taking toward a minority group one is not part of).

3.6.3. Potential covariates: The Toronto Empathy questionnaire and self-reported gender and GPA

In the pre-test measure, participants reported their trait, general empathy using the Toronto Empathy Questionnaire (Spreng et al., 2009, p. 16 items; $\alpha = 0.82$). Participants also indicated how many close friends they had who are LGBTQ+. Close was defined for participants as someone they 'felt' close to. It is likely that people who have more close contact with LGBTQ + people are also likely to be more empathic towards LGBTQ + people and interested in learning about their history (Herek & Capitanio, 1996). In general, participants reported having 2.49 LGBTQ + close friends, on average, ranging from 0 to 10 (three students' reports were missing). Learners' general trait empathy and the number of close LGBTQ + friends were included as covariates because they were expected to influence their perspective-taking toward LGBTQ + people (Herek & Capitanio, 1996). Gender was also included as a covariate because prior research suggests that women are more empathetic and have lower levels of negative attitudes towards LGBTQ + than men (Arndt & De Bruin, 2006; Bettinsoli et al., 2020). Participants also reported their cumulative GPAs because research has shown that prior achievement predicts students' engagement in app-based learning tasks (Cutumisu et al., 2020). Student GPAs (on a 4.0 scale) ranged from 2.00 to 4.00 ($M = 3.03$; $SD = 0.63$; with four missing values).

4. Data analysis

We treated the perspective-taking toward GI and SO separately because GI and SO are different subpopulations of the queer/LGBTQ + community that can be mutually exclusive. For example, someone can be an SO minority (e.g., lesbian) but not a GI minority (e.g., cisgender; identify as a woman). The sizes of SO and GI populations are also dramatically different, with the most recent national Canadian survey placing SO minorities around 4% and GI minorities at 0.33% (Statistics Canada, 2022) which reinforces the point that these are not mutually exclusive populations. Of particular relevance to this article, SO and GI minorities are also in different places with earning human and legal rights in Canada (where this study was conducted) and elsewhere, historically. For example, the Canadian Human Rights Act was amended in 1996 to include sexual orientation as one of the prohibited grounds of discrimination (Government of Canada, 2022a), but only amended in 2017 to protect trans and gender diverse people (Government of Canada, 2022b). These and other historical differences between SO and GI minorities likely reflect different levels of knowledge and perspective-taking amongst the general public, further justifying measuring these discrete populations separately.

To address our research questions we ran a series of 2 (within-subject: pre-test and post-test) × 2 (between-subject: video game vs. history app) mixed factorial ANOVAs in SPSS (IBM Corp, 2019). First, to examine participants' perspective-taking (Q1a&b), the administration of a counter-balanced version of the queer history knowledge test was entered as the two-level within-subject variable (pre- and post-session), the app (vs. control) conditions were entered as the two-level between-subject variable (app or game-based control), and perspective-taking as the dependent variable. To unpack interactions, we ran repeated-measure ANOVAs to examine changes in pre-test and post-test in the app and the control conditions, respectively.

To further address Q1c about whether the app increased perspective-taking through participants' history knowledge, we used MPlus 8.0 (Muthén & Muthén, 1998) to conduct two-wave ANCOVA path models with a latent change score. This approach was found most applicable for pre-test post-test control group design with a mediating variable (Valente & MacKinnon, 2017). Compared to other models (e.g., simplified, difference-score models), research shows that the two-wave ANCOVA path models control for pre-test effect perform better for estimating the mediated effect with lower Type 1 error rates, better coverage of confidence intervals, and higher statistical power (Valente & MacKinnon, 2017). This model is specified to be a saturated model (i.e., with 0 degrees of freedom). As shown in Fig. 3(1), for example, we estimated the path of app (vs. control) condition on ΔKnowledge (i.e., a path), the paths of ΔKnowledge on ΔPerspective-taking toward SO (i.e., b path), as well as the app (vs. control) condition on ΔPerspective-taking toward SO (i.e., c' path). The mediated effect will be estimated as the effect of app (vs. control) conditions on ΔPerspective-taking toward SO through its effect on ΔKnowledge (i.e., a path × b path). We applied 5000 bootstrapping samples to estimate the indirect effect; as such, significant indirect effects are indicated by the confidence intervals that do not include 0. Similarly, Fig. 3(2) showed the testing model for the app (vs. control) conditions on ΔPerspective-taking toward SO via ΔKnowledge.

5. Results

5.1. Preliminary analysis

Descriptive statistics, including means and standard deviations, for all the variables, are presented in Table 1. All statistical assumptions were met, and there were no existing mean differences between the app and the control group on all pre-test measures, suggesting that the randomization was effective.

Correlations among variables are presented in Table 2. We found that the number of LGBTQ + friends positively predicted students' knowledge about LGBTQ + history, as well as perspective-taking towards SO and GI, both in pre-test and post-test ($rs = 0.26$ to 0.42, $p < 0.01$). We also found that women (vs. men) scored lower on post-test knowledge ($r = -0.30$, $p < 0.001$) but not pre-test knowledge; women (vs. men) also scored higher on trait empathy ($rs = 0.37$, $p < 0.001$). As shown in Table 2, correlational analyses supported our use of covariates identified from the literature and collected during the pre-test survey: gender (Arndt & De Bruin, 2006; Bettinsoli et al., 2020), number of close LGBTQ + friends (Herek & Capitanio, 1996), and GPA.

5.2. Q1a,b. Did using the EQH app but not the control app increase learners' perspective-taking toward SO and GI minorities?

We found that the app (vs. control) condition influenced students' perspective-taking towards SO minorities. We found statistically significant interaction effects of condition and administration of perspective-taking self-report, $F(1,99) = 23.37$, $p < 0.001$, $\eta_p^2 = 0.19$ (medium effect size). This interaction remained significant with the controlled variables, $F(1,94) = 20.33$, $p < 0.001$, $\eta_p^2 = 0.18$. As shown in Fig. 4b, simple main effects showed that change was significant for those in the app condition; they scored higher in post-test than pre-test, $F(1,94) = 21.04$, $p < 0.001$, $\eta_p^2 = 0.18$ (a medium effect size). However, those in the control app condition did not statistically significantly change: their pre-test and post-test measures of perspective-taking toward SO did not differ, $F(1,94) = 3.46$, $p = 0.066$, $\eta_p^2 = 0.036$. Additionally, those in the EQH app condition showed statistically significantly higher perspective-taking toward SO than those in the control app condition in the post-test, $F(1,94) = 4.33$, $p = 0.040$, $\eta_p^2 = 0.04$ (a small effect size).

Similarly, we also found that students in the app condition changed their perspective-taking towards GI minorities (Fig. 4c). We found

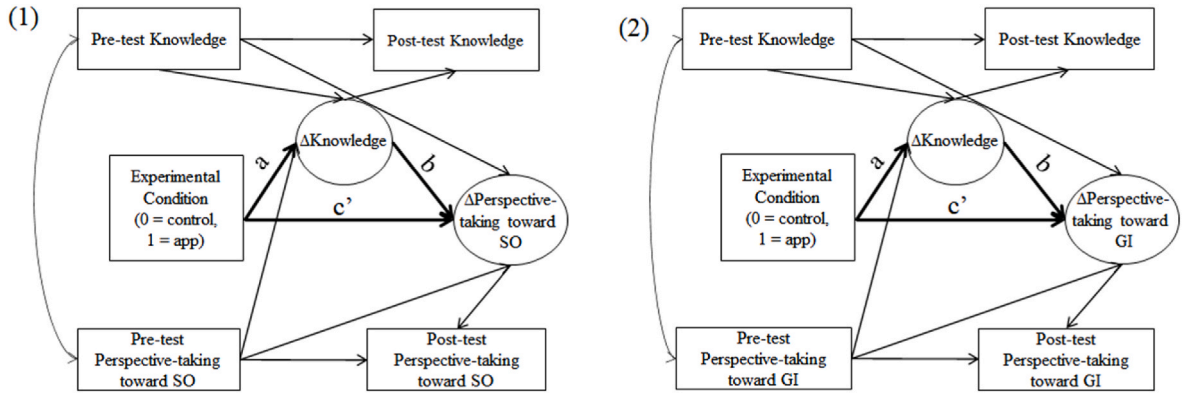


Fig. 3. *Hypothesized Mediation Models of (1) Condition → ΔKnowledge → ΔPerspective-taking toward SO, and (2) Condition → ΔKnowledge → ΔPerspective-taking toward GI.*

Note. ΔKnowledge = the change of knowledge; ΔPerspective-taking = the change of perspective-taking; SO = sexual orientation minority; GI = gender identity minority.

Table 1
Descriptive statistics for study variables by condition.

Variable	Condition	*n*	*M*	*SD*	Observed Range	Possible Range	Skewness	Kurtosis
Pre-test Knowledge	Control	57	7.96	1.73	4.00–13.00	0.00–14.00	0.36	0.36
	App	57	7.77	2.28	3.00–12.00	0.00–14.00	0.32	−0.37
Post-test Knowledge	Control	57	7.84	1.90	4.00–13.00	0.00–14.00	0.30	0.37
	App	57	11.25	1.98	5.00–14.00	0.00–14.00	−0.99	0.71
Pre-test perspective-taking toward SO	Control	51	3.51	0.88	2.14–5.57	1.00–6.00	0.27	−0.34
	App	50	3.24	0.87	1.57–5.14	1.00–6.00	0.15	−0.54
Post-test perspective-taking toward SO	Control	51	3.34	0.84	1.71–5.57	1.00–6.00	0.44	0.31
	App	50	3.63	0.88	1.71–6.00	1.00–6.00	0.53	0.59
Pre-test perspective-taking toward GI	Control	57	3.16	0.81	1.43–5.00	1.00–6.00	0.11	−0.47
	App	56	3.11	0.85	1.57–4.86	1.00–6.00	0.21	−0.63
Post-test perspective-taking toward GI	Control	57	3.31	0.91	1.57–5.43	1.00–6.00	0.67	−0.42
	App	56	3.50	0.88	1.71–6.00	1.00–6.00	0.46	0.51
General trait empathy	Control	57	4.03	0.35	3.13–4.56	1.00–5.00	−0.85	0.19
	App	57	4.08	0.36	3.00–4.94	1.00–5.00	−0.55	1.32
# of close LGBTQ + friends	Control	56	2.73	2.47	0.00–10.00	–	1.02	0.81
	App	55	2.24	2.14	0.00–9.00	–	0.80	0.27
Prior GPA	Control	55	3.14	0.43	2.00–4.00	0.00–4.00	−0.35	−0.15
	App	55	3.08	0.35	2.00–3.90	0.00–4.00	−0.36	1.19

Note. SO = sexual orientation minority; GI = gender identity minority.

Table 2
Zero-order correlations among study variables for the control condition (below diagonal) and app condition (above diagonal).

	1	2	3	4	5	6	7	8	9	10
1.Pre-test Knowledge	–	0.22	0.32*	0.21	0.12	0.10	−0.17	−0.02	0.06	−0.03
2.Post-test Knowledge	0.12	–	0.29*	0.18	0.16	0.06	−0.30*	0.02	0.15	−0.40**
3.Pre-test perspective-taking (SO)	−0.11	0.02	–	0.75***	0.72***	0.54***	0.07	0.39**	−0.02	−0.09
4.Post-test perspective-taking (SO)	0.01	0.18	0.82***	–	0.73***	0.81***	0.17	0.27	−0.04	0.03
5.Pre-test perspective-taking (GI)	0.02	0.34*	0.69**	0.75***	–	0.71***	0.06	0.46**	−0.03	0.04
6.Post-test perspective-taking (GI)	0.04	0.24	0.69***	0.71***	0.88***	–	0.18	0.31*	0.03	0.19
7. General trait empathy	−0.16	−0.14	0.11	0.11	−0.10	−0.08	–	0.21	−0.25	0.45***
8.# of close LGBTQ + friends1	0.21	0.06	0.34*	0.31*	0.39**	0.35**	−0.03	–	−0.03	0.05
9. Prior GPA	−0.30*	0.03	−0.09	−0.12	−0.15	−0.18	0.02	−0.25	–	−0.20
10. Gender (0 = M; 1 = F)	−0.08	−0.22	0.00	−0.06	−0.16	−0.20	0.30*	0.07	−0.18	–

Note. [1]There were missing data from three participants in # of close LGBTQ + friends. [2]One participant who indicated non-binary gender identity was not included in the gender variable.
SO = sexual orientation minority; GI = gender identity minority.
*$p < 0.05$, **$p < 0.01$, ***$p < 0.001$(two-tailed test).

statistically significant interaction effects of condition and administration of perspective-taking toward GI, $F(1,111) = 5.39$, $p = 0.022$, $\eta_p^2 = 0.046$ (small effect size). This interaction was also significant with the controlled variables, $F(1,105) = 4.68$, $p = 0.033$, $\eta_p^2 = 0.043$. Specifically, simple main effect showed that the change was statistically significant for those in the EQH app condition: they scored higher in post-test than pre-test, $F(1,105) = 24.41$, $p < 0.001$, $\eta_p^2 = 0.19$. The change in perspective-taking toward GI minorities from pre-to post-test for those in the control app condition was not statistically significant, $F(1,105) = 3.67$, $p = 0.06$, $\eta_p^2 = 0.03$.

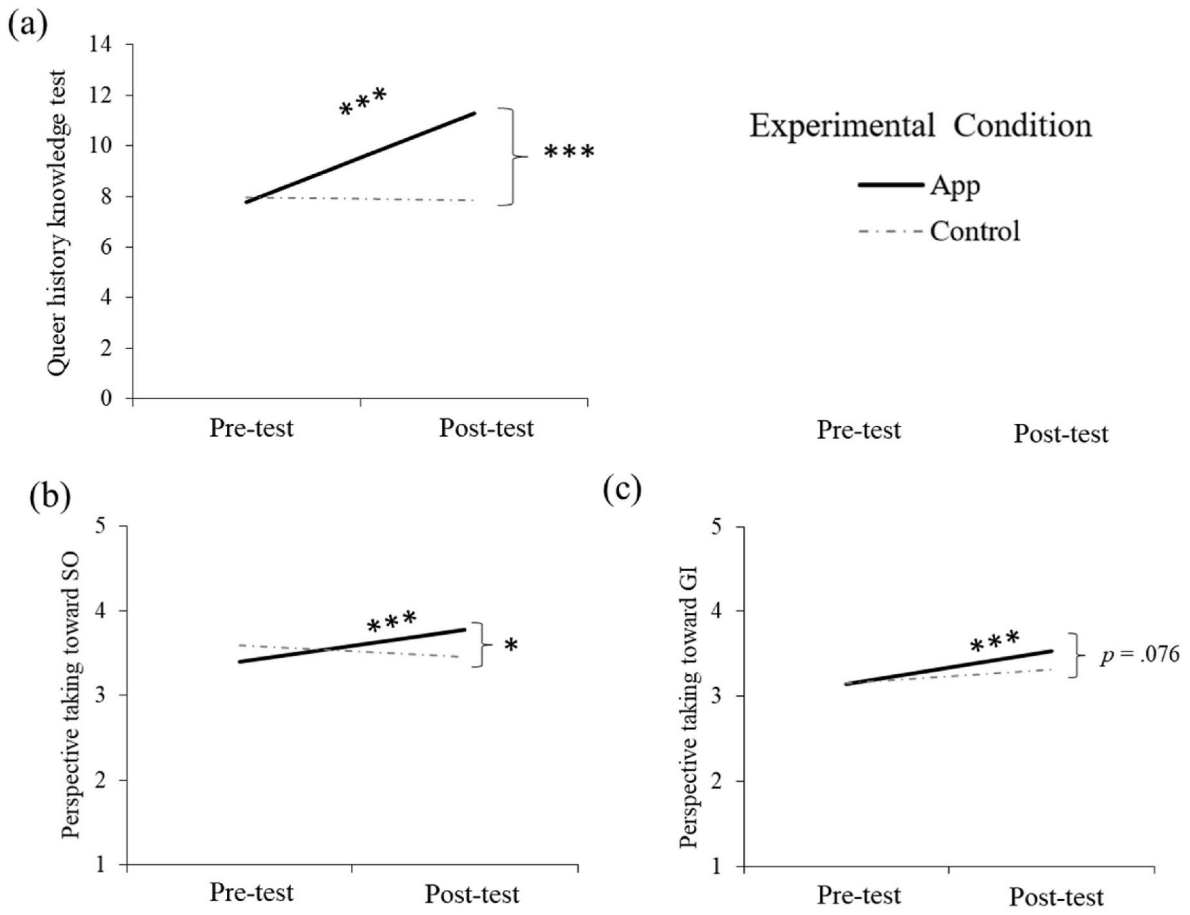


Fig. 4. Interaction between app (vs. control) conditions and two administration of tests (pre-test and post-test) on (a) queer history knowledge, (b) perspective taking toward SO, and GI (c) perspective taking toward GI.
Note. All interaction effects presented are significant.

5.3. Q1.c. did students' increase in knowledge of queer history mediate the effect of condition on their increase in perspective-taking?

Next, we examined whether learning queer history (i.e., changes in the knowledge score) explained the change of perspective-taking in the app versus control conditions. We ran two, two-wave ANCOVA path models (see Fig. 3), with learning as the mediator and perspective-taking toward SO and GI, respectively, as the dependent variable (see Table 3 for path estimation and mediation effect).

For the model with perspective-taking toward SO as an outcome variables shown in Table 3, all a, b' c' paths were significant (see Fig. 3 for an illustration). The indirect effect between the EQH app (vs. control) conditions and the change of perspective-taking was statistically significantly mediated through the change of knowledge. That is, students in the EQH app condition (vs. control) learned significantly more, which in turn predicted their change in perspective-taking toward SO.

For the model with perspective-taking toward GI as the outcome variable, as shown in Table 3, an an' c' are significant, but b paths were not (see Fig. 3 for an illustration). That is, although learners in the app condition increased knowledge and perspective-taking toward GI, the increase of knowledge did not mediate the link between EQH app condition and perspective-taking toward GI.

5.4. Q2.a,b. Did using the EQH app but not the control app increase learners' knowledge about queer history?

Results indicated that the EQH app was highly effective in helping students increase their queer history knowledge. We found a statistically significant interaction effect (with large effect size) of condition and administration of queer history knowledge test, $F(1,112) = 57.00$, $p < 0.001$, $\eta_p^2 = 0.34$. This interaction effect was observed even when controlling for gender, trait empathy, and number of LGBTQ + friends, $F(1,105) = 55.04$, $p < 0.001$, $\eta_p^2 = 0.34$. As shown in Fig. 4a (see also Table 1 for descriptive statistics), simple main effects (with Bonferroni adjustment for Type 1 error) showed that change was significant for those in the EQH app condition (with large effect size); they scored

Table 3
Path coefficients (with standard error in brackets) and mediated effects for two-wave ANCOVA path model.

Model	Path coefficient estimate			indirect effect	95% CI for mediation effect	
	a path	b pat'	c' path	a × b	Upper C·I.	Lower C·I
(1) 1) Condition → ΔKnowledge → ΔPerspective-taking toward SO	3.420*** (0.330)	0.038*** (0.008)	0.347*** (0.093)	**0.117 (0.080)**	**0.050**	**0.178**
(2) Condition → ΔKnowledge → ΔPerspective-taking toward GI	3.328*** (0.259)	−0.017 (0.011)	0.288** (0.088)	−0.057 (0.036)	−0.121	0.018

Note. *$p < 0.05$, **$p < 0.01$, ***$p < 0.001$ (two-tailed test); Significant mediation effects (95% confidence intervals did not include 0) were in bold. See Fig. 1 for the illustration of a, b, an' c' paths for each model.

higher in post-test than pre-test in queer history knowledge, $F(1, 105) = 108.39$, $p < 0.001$, $\eta_p^2 = 0.51$. There was no statistically significant change for those in the control app condition—they did not differ from pre-to post-test on queer history knowledge, $F(1, 105) = 0.01$, $p = 0.93$, $\eta_p^2 = 0.00$. Additionally, those in the app condition showed statistically significantly more knowledge than those in the control condition in the post-test, $F(1,105) = 92.37$, $p < 0.001$, $\eta_p^2 = 0.47$.

6. Discussion

The main results of this study that examined 114 pre-service teachers at a North American university were the following: (1) Compared to students in the control app group, those who were randomly assigned to learn about queer history through the EQH app reported significantly higher levels of perspective-taking toward sexual orientation (SO) and gender identity (GI) minority minorities. Moreover, learning (i.e., increase in queer history knowledge) mediated the EQH app condition's effect (vs. control app condition) on increased perspective-taking toward SO but not GI minorities. (2) Students randomly assigned to the EQH app condition increased their queer history knowledge significantly while those assigned to the control app condition game did not.

Our findings are important for several reasons. From a scientific point of view, the present study helps address several gaps in the literature. For one, there is a paucity of research examining educational interventions to support queer history learning or perspective-taking toward LGBTQ + people. More broadly, there is little research to-date that uses educational technology as a medium to support learning about equity, diversity, and inclusion. This study provided evidence that our instructional content was effective and an app seemed to be an effective means of organizing and sharing it. It is, however, important to note that we cannot claim from our findings that a text and image-only version would have been worse, the same, or better as we did not have such a version of the content as a control (see limitations section). That said, the theories and design principles we drew on led us to hypothesize that text and image-only would be less effective than our app modality.

Further, while there is a body of work on historical empathy, little of it is quantitative or mixed methods, which limits the range of research questions and associated claims that can be made from this important work. Another contribution our findings make is supporting our instructional design decisions which drew on a number of theoretical and conceptual frameworks that had not been applied to queer history previously outside of our previous research with this app (Harley et al., 2019, Harley et al., 2020a). As our prior research did not include a control condition, our current findings strengthen claims that can be made about the effectiveness of our queer history app which may help inspire or guide future instructional development and research.

Our findings also make several broader educational and societal contributions. First, they support the use of the EQH app as a supplementary educational resource for pre-service teachers to learn about queer history. On a larger scale, our app could therefore be incorporated into preservice teachers' training to help fill current gaps in social studies and history teachers' knowledge of their subject area (Efstathiou et al., 2018; Herrera et al., 2018; Lindgren, 2012; Roberts et al., 2014; Verkuyten & Thijs, 2013) that they do not always have the time or support to do themselves. In turn, teachers who have learned about history from the app could choose to integrate it or some of its content into their classroom activities or assignments addressing this gap in historical knowledge for their students while also potentially supporting enhancing their own and their students' perspective-taking toward LGBTQ + minorities. Similarly, our app may be used in teacher education programs and to support continuing education of LGBTQ+ and non-LGQBTQ + people curious about queer history and the important role their city, country, and its citizens played in advancing LGBTQ + rights. To-date our app has had some preliminary indicators that there may be broader interest in it including being featured on the city of Edmonton tourism website and appearing in the city of Edmonton official Pride program as well as local and national media.

Though it was beyond the scope of our current study to examine, learning about and increasing perspective-taking toward LGBTQ + minorities has the potential to decrease prejudice and increase sensitivity toward them. This stands to improve LGBTQ + minorities lives as well as equip non-LGBTQ + people with the ability to better communicate and collaborate with a more diverse array of people than they may have in their social or familial spheres. Changing attitudes and behaviors toward LGBTQ + people is a large-scale endeavor but changing—for the better—people's knowledge of and perspective-taking toward them are meaningful steps to getting there.

7. Limitations, strengths and future directions

Our research objectives were to assess whether the EQH app, including its multimedia (videos, pictures, and audio) content, could be used to enhance perspective-taking and EQH knowledge. Therefore, examining what effect different educational modalities (i.e., mediums) presenting the same or similar content may have had was outside the scope of our current study and objectives. Furthermore, the historical videos and audio in the EQH App would have needed to be transcribed for a text-and-image based control (common modality control) which we believe would be less effective, impractical and not an effective control for our app. Additionally, a second control condition would, at minimum, have required another 50+ participants (2-h sessions each), which was beyond the human (e.g., participant subject pool availability) and financial resources of the current study. Medium or smaller sample sizes are a common limitation of lab-based educational technology research which also tends to use either a single control group or no control group (Cutumisu & Lou, 2020; Dever et al., 2021; Dietrich et al., 2021; Geden et al., 2021; Harborth & Pape, 2021; Lajoie et al., 2021; Li et al., 2021; Taub et al., 2018). In summary, while our sample size was appropriate for the analyses we conducted, adding a second control condition would have would have greatly limited the statistical power of our models and yielded findings of little practical or scientific use.

Considering the EQH app's high usability and positive emotional engagement (Harley et al., 2019) coupled with its features that include interactive maps, image galleries, historical video footage, and interview recordings with prominent and influential LGBTQ elders, we hypothesize that a text-only or text-and-image-only version of the EQH app would lose some of its educational 'power'. Different modalities, especially traditional ones, may lack the orchestrated package of historical queer figures recounting their experiences in their own voices (audio), landmark events unfolding in archival videos, and students being able to use and 'move' within digital maps and street views to compare the past and present locations (see Fig. 2). These losses, we believe, could have translated into reduced increases in perspective-taking and, potentially, knowledge. That said, examining the potential role of technological medium on knowledge and perspective-taking represents a valuable future direction to explore. Moreover, future longitudinal experiments may examine whether the statistically significant increases in perspective-taking and knowledge were sustained and whether they influenced any subsequent behaviors (e.g., becoming an LGBTQ + person's ally, donating to an LGBTQ + organization; promoting LGBTQ + rights; see Galinsky et al., 2005; Greenaway et al., 2016; Mashuri et al., 2017).

This study was limited by our reliance on self-report data to assess perspective-taking though high reliability and correlations with knowledge in the expected direction (external validity indicator) provide confidence in their robustness.

Our results revealed that the EQH app was more effective at increasing perspective-taking toward SO than GI minorities. This is possibly because only a small amount of content was available in the app about the history of trans and non-binary rights, reflecting how behind we are in GI relative to SO rights. Therefore, future research may include more GI knowledge and assessment content to better understand the role

of learning via mobile apps on perspective-taking toward GI minorities.

The sample of this study consisted of undergraduate pre-service teachers, which limits the generalizability of findings. That said, a previous study with the EQH app and undergraduate students from diverse educational backgrounds (i.e., majors) revealed similarly high post-test knowledge (Harley et al., 2019). By deliberately targeting future teachers in this study, we not only gained access to a participant pool to run this time-intensive study but were able to introduce prospective teachers to the app so that they might use it or direct colleagues to use it in their high school classrooms to help address gaps in the province's history curriculum. Future research should examine perspective-taking and learning outcomes with the EQH app with high school students in a quasi-experimental design (RCT, not likely to be feasible). Positive findings reported in this article stand to help encourage pre-service teachers and principals to spend some of their valuable and limited time learning with and considering adopting the app, especially as part of a study, in their schools and classrooms. Future research with a larger sample size should also formally examine potential differences in learning and perspective-taking with racial and cultural minorities, some of whom may develop perspective-taking skills at higher rates than participants who are part of the racial and ethnocultural majority (Bettinsoli et al., 2020; Dey et al., 2010). Future research and development could also explore using our app in different Canadian cities or leveraging our design decisions and adapting content to include local historical places and events.

Around the time data was collected for this study, stories were circulating in local media about schools failing to meet new legislative requirements advanced by the current provincial government to protect LGBTQ + students and staff (French, 2018a, 2018b). On the other hand, a higher education institution with a problematic history with the LGBTQ + community held its first pride (Simons, 2018). These and other local political and social issues, such as police, military, and the official opposition party being banned from future Pride Parades (CBC News, 2018a) may have influenced participants' attitudes toward our study as well as LGBTQ + topics in general. While beyond the scope of this study, it would be interesting to conduct a future study comparing different cohorts of pre-service teachers' perspective-taking and queer history knowledge while controlling for their level of awareness of local, national, and international LGBTQ + issues. We hypothesize that our app can help support increasing perspective-taking toward SO and GI individuals regardless of events taking place and participants' awareness of them. That said, insight into the conditions and circumstances the app might be most or least effective could be helpful for instructional planning and the creation of additional or further supplemental content to better contextualize historical events.

Results from the pilot (i.e., previous) study with the EQH App (Harley et al., 2019) and the public launch of the EQH App also received some media and public attention (e.g., CBC News, 2018b; Cook, 2018). We surveyed participants about their potential interaction with an app to learn about history and the history of their city, in particular, prior to scheduling them for the study. None of the participants reported having used such an app which could have otherwise potentially influenced their motivation to participate as well as their knowledge about and perspective-taking toward SO and GIs. These accounts suggest that our study was crucial to providing pre-service teachers with an opportunity to use our apps as none of them reported having done so previously. Given the increasing recognition of the importance of teachers and preservice teachers being able to support SO and GI students we considered this a positive development.

8. Conclusion

This study provides evidence that the EQH app is an effective educational tool for enhancing pre-service teacher learning about SO and GI minority history education: Students learned more about queer history, and increased self-reported perspective-taking toward SO and GI minorities. Queer history knowledge explained the effect of the EQH app on the increase in perspective-taking toward SO minorities. Our study responds to a number of calls to action from the educational research community and our findings contribute to addressing numerous gaps in the literature, including educational interventions to support queer history learning and perspective-taking toward LGBTQ + people. The EQH app may also be a promising tool to help address gaps in pre-service teachers' and high school students' history and social science curriculums. In particular, if our results from the former translate in future research to the latter group and if pre-service teachers who use the EQH app begin to introduce it into their classrooms. This future goal is an important one as increasing empathy can decrease prejudice toward minority groups (Galinsky et al., 2005; Galinsky & Moskowitz, 2000; Mashuri et al., 2017): something the LGBTQ + population continues to disproportionally experience (Nadal, 2019; Statistics Canada, 2021b; US Department of United States Department of Justice, 2020).

CRediT authorship contribution statement

Jason M. Harley: Conceptualization, Data curation, Formal analysis, Funding acquisition, Investigation, Methodology, Project administration, Resources, Software, Supervision, Validation, Visualization, Writing – original draft, Writing – review & editing. **Nigel Mantou Lou:** Formal analysis, Writing – original draft, Writing – review & editing. **Byunghoon "Tony" Ahn:** Data curation, Investigation, Methodology, Project administration, Writing – original draft, Writing – review & editing. **Yang S. Liu:** Data curation, Investigation, Methodology, Project administration, Writing – review & editing.

Declaration of competing interest

The authors have no conflicts of interest or any other declarations of interest to report.

Data availability

The authors do not have permission to share data.

Acknowledgement

This research was supported by funding from the Killam Research Foundation and administered by the University of Alberta, Canada, and the Social Sciences and Humanities Research Council (SSHRC) of Canada [grant ID: 430-2016-01133] awarded to the first author. We thank Murray Billett, Brad Fraser, Darrin Hagen, the Honorable Judge Julie Lloyd, Elizabeth Massiah, Michael Phair, and Dr. Lorne Warneke for generously sharing their time, experiences, and historical perspectives in interviews that helped inform the development of the Edmonton Queer History App. We also thank Dr. Susanne P. Lajoie, Dr. Andre P. Grace, Chayse Haldane, Andrea Whittaker, and Brea McLaughlin for their support in the development and/or early research with the app. Acknowledgements to all individuals who contributed to various stages of the app's development (e.g., interviews, multimedia content sharing, etc) are made within the Edmonton Queer History App—thank you! The desktop version of the EQH app can be accessed here: https://izi.travel/en/0468-edmonton-queer-history-app/en.

Appendix A

Task instructions from the experimental protocol read to participants directly below:

Queer History App Condition: This is the web browser version of the Queer History App. You will use this App to learn about significant historical landmarks related to queer history in Edmonton. You may start by reading the summary, and by watching this short video for instructions on how to use the app. Do you have any questions about how to use the app?.. Okay, now you are ready to learn about historically significant queer history locations in [Blinded]. Please let me know when you have completed the virtual tour. Please also let me know if you have any questions."

Game App Condition: The game you will be playing is called "Plants vs. Zombies". You are going to play this game for 30 min. Do you have any questions about playing this game?.. I will let you know when you have reached 30 min and will also give you a 1-min warning before your 30 min are up. Please also let me know if you have any questions."

Appendix B

Queer History Knowledge Test Example Items

Why was there such outrage from the LGBTQ + community when the Pisces Bathhouse Raids happened?

a) The Pisces Bathhouse was a secret LGBTQ + club whose members were no longer anonymous after the raids.
b) * The safety and privacy of the Bathhouse was valued by its patrons, and the raids were a direct violation of those values.
c) As a result of the police raiding the Bathhouse in their work shoes, too many towels went to waste cleaning up their dirty footprints from the tile floors.
d) Shutting the Pisces Bathhouse down meant there was one less place to go in Edmonton to socialize.

What does the Club 70 story say about the availability of social gathering places for gay men?

a) Having a social life as a gay man in Edmonton was easy.
b) * Gay men had to take it upon themselves to create welcoming, safe spaces for them to socialize in and have fun in their city.
c) The owners and proprietors of social establishments in Edmonton were welcoming of gay men as clientele.
d) There were lots of places for gay men to socialize, but they used private memberships to make the clubs more exclusive

What was the significance of places such as Jazzberrys and Common Woman Books?

a) *They were key for the dissemination of information within the LGBTQ + community
b) They were exclusive clubs for people from the LGBTQ + community
c) They were the only places where members from the LGBTQ + community could feel safe
d) They offered discounts on books and coffee to people from the LGBTQ + community

What was the significance of the opening of Flashback?

a) You did not need a membership to get in
b) *Unlike Club 70, you did not have to prove you were gay
c) You could bring your own alcohol into the club
d) Unlike Club 70, you could enter the club from the front door

What was the main reason Dr. Warneke decided to open a gender clinic at the Grey Nuns hospital in 1996?

a) To make more money, since widespread LGBTQ + disrcimination led to him losing clients in his private practice
b) To create a safe place for transgender people in Edmonton to get plastic surgery
c) To create a support group for families of transgender individuals
d) *To combat the widespread stigmatization of transgender people in medicine and psychiatry

Appendix C

Instructions and Example Items from Wang et al. (2003) Modified Scale of Ethnocultural Empathy (SEE): Scale of Gay, Lesbian, and Bisexual Empathy

Instructions: Please respond to the questions below, thinking of people with a different sexual orientation than your own. In other words, if you identify as straight (i.e., heterosexual), please fill this out thinking of lesbian, gay, and bisexual individuals (i.e., LGB). If, however, you identify as a lesbian, gay, or bisexual individual please see the following instructions.

- *if you identify as a bisexual individual, please fill this out thinking of gay and lesbian individuals.*
- *If you identify as a gay or lesbian individual, please fill this out thinking of bisexual individuals.*

Please record your answers using the appropriate number, where 1 = "strongly disagree that it describes me" and 6 = "strongly agree that it describes me". Please see definitions, as needed.

1. It is easy for me to understand what it would feel like to be a gay, lesbian, and/or bisexual person with a sexual orientation different other than my own.
2. It is difficult for me to relate to stories in which people talk about homophobic discrimination they experience in their day to day lives.
3. It is difficult for me to put myself in the shoes of someone who has a different sexual orientation from me.
4. I know what it feels like to be the only person of a certain sexual orientation in a group of people.

Examples of original item wording (Wang et al., 2003):

1. It is easy for me to understand what it would feel like to be a person of another racial or ethnic background other than my own.
2. It is difficult for me to relate to stories in which people talk about racial or ethnic discrimination they experience in their day to day lives.

Appendix D

Instructions and Example Items from Wang et al. (2003) Modified Scale of Ethnocultural Empathy (SEE): Scale of Transgender and Non-binary Empathy

Instructions: Please respond to the questions below, thinking of people with a different gender identity than your own. In other words, if you identify as a *cis*-gender individual, please fill this out thinking of non-binary and transgender individuals. If you identify as a non-binary individual, please fill this out thinking of transgender individuals. If you identify as a transgender individual, please fill this out thinking of non-binary individuals.

Please record your answers using the appropriate number, where 1 = "strongly disagree that it describes me" and 6 = "strongly agree that it describes me". Please see definitions, as needed.

5. I can relate to the frustration that some people feel about having fewer opportunities due to their sexual orientation.
6. I feel uncomfortable when I am around a significant number of people who have a different sexual orientation than me.
7. I don't know a lot of information about important social and political events of people with different sexual orientations than my own.

Example of former item wording:

5. I can relate to the frustration that some people feel about having fewer opportunities due to their non *cis*-gender identity.
6. I feel uncomfortable when I am around a significant number of people who have a non *cis*-gender identity.

References

Ahn, B.T., & Harley, **J.M** (2020). Facial expressions when learning with a queer history app: application of the control value theory of achievement emotions. *British Journal of Educational Technology, 51*(5), 1563–1576. https://doi.org/10.1111/bjet.12989.

Airton, L., & Koecher, A. (2019). How to hit a moving target: 35 years of gender and sexual diversity in teacher education. *Teaching and Teacher Education, 80*, 190–204.

Alix, F. A. (2020). LGBTQ youth and technology: Finding their way through online intersect. *Communities. Intersect: The Stanford Journal of Science, Technology, and Society, 14*(2), 1–11.

American Educational Research Association (AERA). (2021). *Statement from AERA president Shaun R Harper and executive director Felice J. Levine in support of transgender and non-binary persons.* Retrieved from https://www.aera.net/Newsroom/Statement-from-AERA-President-Shaun-R-Harper-and-Executive-Director-Felice-J-Levine-in-Support-of-Transgender-and-Non-Binary-Persons.

Arndt, M., & De Bruin, G. (2006). Attitudes toward lesbians and gay men: Relations with gender, race and religion among university students. *Psychology, Soci, 33*, 16–30.

Bartelds, H., Savenije, G. M., & Van Boxtel, C. (2020). Students' and teachers' beliefs about historical empathy in secondary history education. *Theory & Research in Social Education, 48*(4), 529–551.

Bettinsoli, M. L., Suppes, A., & Napier, J. L. (2020). Predictors of attitudes toward gay men and lesbian women in 23 countries. *Social Psychological and Personality Science, 11*(5), 697–708. https://doi.org/10.1177/1948550619887785

Broockman, D., & Kalla, J. (2016). Durably reducing transphobia: A field experiment on door-to-door canvassing. *Science, 352*(6282), 220–224. https://doi.org/10.1126/science.aad9713

CBC News. (2018a). *Edmonton police, RCMP, military banned from future Pride parades.* CBC News. Retrieved from https://www.cbc.ca/news/canada/edmonton/edmonton-pride-parade-lgbtq-politics-alberta-1.4699694.

CBC News. (2018b). *'Queer History' app documents Edmonton's LGBTQ history.* CBC News. Retrieved from: https://www.cbc.ca/news/canada/edmonton/edmonton-queer-history-app-1.4692048.

Ceuterick, M. (2021). Queering cultural memory through technology: Transitional spaces in AR and VR. *Alpha: Journal of Film and Screen Media*, (21), 89–110. https://doi.org/10.33178/alpha.21.05

Chesham, A., Wyss, P., Müri, R. M., Mosimann, U. P., & Nef, T. (2017). What older people like to play: Genre preferences and acceptance of casual games. *JMIR Serious Games, 5*(2), e8. https://doi.org/10.2196/games.7025

Clark, C. T. (2010). Preparing LGBTQ-allies and combating homophobia in a US teacher education program. *Teaching and Teacher Education, 26*(3), 704–713.

Cole, E. A. (2007). Transitional justice and the reform of history education. *International Journal of Transitional Justice, 1*(1), 115–137. https://doi.org/10.1093/ijtj/ijm003
Cook, S. (2018). Edmonton queer history app launches in time for Pride. *Edmonton Journal*. Retrieved from https://edmontonjournal.com/news/local-news/queer-history-app.
Crompton, H., Burke, D., & Gregory, K. H. (2017). The use of mobile learning in PK-12 education: A systematic review. *Computers & Education, 110*, 51–63. https://doi.org/10.1016/j.compedu.2017.03.013
Cutumisu, M., Schwartz, D. L., & Lou, N. M. (2020). *The relation between academic achievement and the spontaneous use of design-thinking strategies*. Computers & Education, Article 103806. https://doi.org/10.1016/j.compedu.2020.103806
DeBerry, J. A., Adams, E. M., Cascalheira, C. J., & Hitter, T. L. (2023). The effectiveness of didactic and perspective-taking interventions on reducing multiple dimensions of heterosexism. *Journal of Homosexuality, 70*(10), 2295–2318.
Dever, D. A., Cloude, E. B., & Azevedo, R. (2021). Examining learners' reflections over time during game-based learning. In I. Roll, D. McNamara, S. Sosnovsky, R. Luckin, & V. Dimitrova (Eds.), *Lecture notes in computer science: Vol. 12749. Artificial intelligence in education. AIED 2021*. Cham: Springer. https://doi.org/10.1007/978-3-030-78270-2_23.
Dey, E. L., Ott, M. C., Antonaros, M., Barnhardt, C. L., & Holsapple, M. A. (2010). *Engaging diverse viewpoints: What is the campus climate for perspective-taking?* Washington, DC: Association of American Colleges and Universities.
Di Stasio, M., Alston, L., & Harley, J. M. (2023). A snapshot of gay-straight alliance clubs and student well-being in alberta schools. *Canadian Journal of School Psychology, 38*(2), 144–158. https://doi.org/10.1177/08295735231170337
Dietrich, J., Greiner, F., Weber-Liel, D., Berweger, B., Kämpfe, N., & Kracke, B. (2021). Does an individualized learning design improve university student online learning? A randomized field experiment. *Computers in Human Behavior, 122*, Article 106819. https://doi.org/10.1016/j.chb.2021.106819
Dulberg, N. (2002). *Engaging in history: Empathy and perspective-taking in children's historical thinking*. New Orleans, LA: Annual Meeting of the American Educational Research Association.
Efstathiou, I., Kyza, E. A., & Georgiou, Y. (2018). An inquiry-based augmented reality mobile learning approach to fostering primary school students' historical reasoning in non-formal settings. *Interactive Learning Environments, 26*(1), 22–41. https://doi.org/10.1080/10494820.2016.1276076
Einfeld, A., & Collins, D. (2008). The relationships between service-learning, social justice, multicultural competence, and civic engagement. *Journal of College Student Development, 49*(2), 95–109. https://doi.org/10.1353/csd.2008.0017
Ertmer, P. A., & Newby, T. J. (2013). Behaviorism, cognitivism, constructivism: Comparing critical features from an instructional design perspective. *Performance Improvement Quarterly, 26*(2), 43–71.
Fetner, T., & Elafros, A. (2015). The GSA difference: LGBTQ and ally experiences in high schools with and without gay-straight alliances. *Social Sciences, 4*(3), 563–581. https://doi.org/10.3390/socsci4030563
Foster, S. (1999). Using historical empathy to excite students about the study of history: Can you empathize with Neville Chamberlain? *The Social Studies, 90*(1), 18–24. https://doi.org/10.1080/00377999909602386
French, J. (2018a). School LGBTQ policies out of step with School Act changes, advocacy group says. *Edmonton Journal*. Retrieved from https://edmontonjournal.com/news/local-news/school-lgbtq-policies-out-of-step-with-school-act-changes-advocacy-group-says.
French, J. (2018b). Alberta private schools running afoul of gay-straight alliance law, minister says. *Edmonton Journal*, 61. Retrieved from https://edmontonjournal.com/news/local-news/61-alberta-private-schools-running-afoul-of-gay-straight-alliance-law-minister-says.
Gachago, D., Condy, J., Ivala, E., & Chigona, A. (2014). All stories bring hope because stories bring awaren'ss': stude'ts' perceptions of digital storytelling for social justice education. *South African Journal of Education, 34*(4), 1–12. https://hdl.handle.net/10520/EJC162724.
Galinsky, A. D., Ku, G., & Wang, C. S. (2005). Perspective-taking and self-other overlap: Fostering social bonds and facilitating social coordination. *Group Processes & Intergroup Relations, 8*(2), 109–124. https://doi.org/10.1177/1368430205051060
Galinsky, A. D., & Moskowitz, G. B. (2000). Perspective-taking: Decreasing stereotype expression, stereotype accessibility, and in-group favoritism. *Journal of Personality and Social Psychology, 78*(4), 708–724. https://doi.org/10.1037/0022-3514.78.4.708
Geden, M., Emerson, A., Carpenter, D., Rowe, J., Azevedo, R., & Lester, J. (2021). Predictive student modeling in game-based learning environments with word embedding representations of reflection. *International Journal of Artificial Intelligence in Education, 31*, 1–23. https://doi.org/10.1007/s40593-020-00220-4
Gehlbach, H., Brinkworth, M. E., & Wang, M.-T. (2012). The social perspective taking process: What motivates individuals to take another's perspective? *Teachers College Record, 114*(1), 197–225. http://www.tcrecord.org/library/content.asp?contentid=16208.
Government of Canada. (2022a). *Rights of LGBTI persons*. Retrieved from https://www.canada.ca/en/canadian-heritage/services/rights-lgbti-persons.html.
Government of Canada. (2022b). *Celebrating five years of legal protections for gender identity and gender expression*. Retrieved from https://www.canada.ca/en/women-gender-equality/news/2022/06/celebrating-five-years-of-legal-protections-for-gender-identity-and-gender-expression.html.
Greenaway, K. H., Cichocka, A., van Veelen, R., Likki, T., & Branscombe, N. R. (2016). Feeling hopeful inspires support for social change. *Political Psychology, 37*(1), 89–107. https://doi.org/10.1111/pops.12225
Haldane, C., Lou, N. M., & Harley, J. M. (2023). Social-historical accounts of identity processes and resilience: Experiences of prominent elders of the LGBTQ+ community. *Journal of Homosexuality, 70*(3), 387–426.
Harborth, D., & Pape, S. (2021). Investigating privacy concerns related to mobile augmented reality Apps–A vignette based online experiment. *Computers in Human Behavior, 122*, Article 106833. https://doi.org/10.1016/j.chb.2021.106833
Harley, J. M.. Edmonton Queer *History App*. (Version 1.0) [Mobile App]. https://izi.travel/en/0468-edmonton-queer-history-app/en.
Harley, J. M., Lajoie, S. P., Tressel, T., & Jarrell, A. (2020b). Fostering positive emotions and history learning with location-based augmented reality and tour-guide prompts. *Learning & Instruction, 70*, 1–16. https://doi.org/10.1016/j.learninstruc.2018.09.001
Harley, J. M., Liu, Y., Ahn, B. T., Lajoie, S. P., & Grace, A. P. (2020a). Examining physiological and self-report indicators of empathy during learners' interaction with a queer history app. *British Journal of Educational Technology, 51*(6), 1920–1937. https://doi.org/10.1111/bjet.13019
Harley, J. M., Liu, Y., Ahn, T. B., Lajoie, S. P., Grace, A. P., Haldane, C., Whittaker, A., & McLaughlin, B. (2019). I've got this: Fostering topic and technology-related emotional engagement and queer history knowledge with a mobile app. *Contemporary Educational Psychology, 59*, 1–18. https://doi.org/10.1016/j.cedpsych.2019.101790
Harley, J. M., Poitras, E. G., Jarrell, A., Duffy, M. C., & Lajoie, S. P. (2016). Comparing virtual and location-based augmented reality mobile learning: Emotions and learning outcomes. *Educational Technology Research and Development, 64*(3), 359–388. https://doi.org/10.1007/s11423-015-9420-7
Herek, G. M., & Capitanio, J. P. (1996). "Some of my best friends" intergroup contact, concealable stigma, and heterosexuals' attitudes toward gay men and lesbians. *Personality and Social Psychology Bulletin, 22*(4), 412–424. https://doi.org/10.1177/0146167296224007
Herrera, F., Bailenson, J., Weisz, E., Ogle, E., & Zaki, J. (2018). Building long-term empathy: A large-scale comparison of traditional and virtual reality perspective-taking. *PLoS One, 13*(10), Article e0204494. https://doi.org/10.1371/journal.pone.0204494
Huijgen, T., van Boxtel, C., van de Grift, W., & Holthuis, P. (2017). Toward historical perspective taking: Students' reasoning when contextualizing the actions of people in the past. *Theory & Research in Social Education, 45*(1), 110–144. https://doi.org/10.1080/00933104.2016.1208587
Hwang, G. J., Wu, P. H., Zhuang, Y. Y., & Huang, Y. M. (2013). Effects of the inquiry-based mobile learning model on the cognitive load and learning achievement of students. *Interactive Learning Environments, 21*(4), 338–354. https://doi.org/10.1080/10494820.2011.575789
IBM Corp. (2019). *IBM SPSS statistics for Windows, version 20*. Armonk, NY: IBM Corp [Computer software].
izi.TRAVEL. [Mobile App Content Management System]. https://izi.travel/en.
Johannes, N., Vuorre, M., & Przybylski, A. K. (2020). Video game play is positively correlated with well-being. *Royal Society Open Science, 8*(2), Article 202049. https://doi.org/10.1098/rsos.202049
Keating, D. P. (1990). Adolescent thinking. In S. S. Feldman, & G. R. Elliott (Eds.), *At the threshold: The developing adolescent* (pp. 54–89). Harvard University Press.
Keynes, M., Elmersjö, H.Å., Lindmark, D., & Norlin, B. (2021). *Introduction: Connecting*.
Kim, H. M. (2013). Mobile media technology and popular mobile games in contemporary society. *International Journal of Mobile Marketing, 8*(2), 42–54.
Kosciw, J. G., Clark, C. M., & Menard, L. (2022). *The 2021 National School Climate Survey: The experiences of LGBTQ+ youth in our nation's schools. A Report from GLSEN*. New York: Gay, Lesbian and Straight Education Network (GLSEN). Retrieved on Jan 10, 2024 from: https://eric.ed.gov/?id=ED625378.
Lajoie, S. P., Zheng, J., Li, S., Jarrell, A., & Gube, M. (2021). Examining the interplay of affect and self regulation in the context of clinical reasoning. *Learning and Instruction*., Article 101219. https://doi.org/10.1016/j.learninstruc.2019.101219
Lentin, A., & Humphry, J. (2017). Antiracism apps: Framing understandings and approaches to antiracism education and intervention. *Information, Communication & Society, 20*(10), 1539–1553. https://doi.org/10.1080/1369118X2016.1240824
Li, S., Zheng, J., Lajoie, S. P., & Wiseman, J. (2021). Examining the relationship between emotion variability, self-regulated learning, and task performance in an intelligent tutoring system. *Educational Technology Research & Development, 69*, 673–692.
Lindgren, R. (2012). Generating a learning stance through perspective-taking in a virtual environment. *Computers in Human Behavior, 28*(4), 1130–1139. https://doi.org/10.1016/j.chb.2012.01.021
Liu, M., Scordino, R., Geurtz, R., Navarrete, C., Ko, Y., & Lim, M. (2014). A look at research on mobile learning in K–12 education from 2007 to the present. *Journal of Research on Technology in Education, 46*(4), 325–372. https://doi.org/10.1080/15391523.2014.925681
Malewski, E., Sharma, S., & Phillion, J. (2012). How international field experiences promote cross-cultural awareness in preservice teachers through experiential learning: Findings from a six-year collective case study. *Teachers College Record, 114*(8), n8.
Margolies, L., & Brown, C. G. (2019). Increasing cultural competence with LGBTQ patients. *Nursing, 49*(6), 34–40.
Mashuri, A., Zaduqisti, E., Sukmawati, F., & Sakdiah, H. (2017). The effect of a majority group's perspective-taking on minority helping. *Psychological Studies, 62*(1), 60–69. https://doi.org/10.1007/s12646-017-0386-x
Mayer, R. E. (2005). Cognitive theory of multimedia learning. In R. Mayer (Ed.), *Cambridge handbook of multimedia learning* (pp. 31–48). New York: Cambridge University Press.
Mayer, R. E. (2019). How multimedia can improve learning and instruction. In J. Dunlosky, & K. A. Rawson (Eds.), *The cambridge handbook of cognition and*

education (1st ed., pp. 460–479). Cambridge University Press. https://doi.org/10.1017/9781108235631.019.
McVee, M. B. (2014). "Some are way left, like this guy, Gloria Ladson-Billings": Resistance, conflict, and perspective taking in teachers' discussions of multicultural education. *Peace and Conflict: Journal of Peace Psychology, 20*(4), 536–551. https://doi.org/10.1037/pac0000067
Merikivi, J., Tuunainen, V., & Nguyen, D. (2017). What makes continued mobile gaming enjoyable? *Computers in Human Behavior, 68*, 411–421. https://doi.org/10.1016/j.chb.2016.11.070
Mohamed, A. L., & Al-Hidabi, D. A. Y. (2019). Mobile device-based authentic learning in educational environments: A systematic review. *IIUM Journal of Educational Studies, 7*(2), 40–55. https://doi.org/10.31436/ijes.v7i2.270
Muthén, L. K., & Muthén, B. O. (1998). *MPlus user's guide* (8th ed.). Los Angeles, CA: Author.
Nadal, K. L. (2019). A decade of microaggression research and LGBTQ communities: An introduction to the special issue. *Journal of Homosexuality, 66*(10), 1309–1316. https://doi.org/10.1080/00918369.2018.1539582
Naylor, A., & Gibbs, J. (2018). Deep learning: Enriching teacher training through mobile technology and international collaboration. *International Journal of Mobile and Blended Learning, 10*(1), 62–77. https://doi.org/10.4018/ijmbl.2018010105
Papenberg, M. (2018). *minDiff-package: The minDiff package*. Retrieved from https://github.com/m-Py/minDiff.
Papendieck, A. (2018). Technology for equity and social justice in education: A critical issue overview. *Texas Education Review, 6*(1), 1–9. https://doi.org/10.15781/T2891278V
Pekrun, R. (2006). The control-value theory of achievement emotions: Assumptions, corollaries, and implications for educational research and practice. *Educational Psychology Review, 18*(4), 315–341. https://doi.org/10.1007/s10648-006-9029-9
Pekrun, R. (2018). Control-value theory: A social-cognitive approach to achievement emotions. In G. A. D. Liem, & D. M. McInerney (Eds.), *Big theories revisited 2: A volume of research on sociocultural influences on motivation and learning* (pp. 162–190). Information Age Publishing.
Peter, T., Campbell, C. P., & Taylor, C. (2021). *Still every class in every school: Final report on the second climate survey on homophobia, biphobia, and transphobia in Canadian schools*. Toronto, ON: Egale Canada Human Rights Trust.
Pettigrew, T. F., & Tropp, L. R. (2008). How does intergroup contact reduce prejudice? Meta-analytic tests of three mediators. *European Journal of Social Psychology, 38*(6), 922–934. https://doi.org/10.1002/ejsp.504
Plass, J. L., & Kaplan, U. (2016). Emotional design in digital media for learning. In S. Tettegah, & M. Gartmeier (Eds.), *Emotions, technology, design, and learning* (pp. 131–161). New York, NY: Elsevier.
Popcap Games (n.d.). Plants vs. Zombies. https://www.ea.com/ea-studios/popcap/plants-vs-zombies..
Poitras, E. G., Harley, J. M., & Liu, Y. (2019). Achievement emotions with location-based mobile augmented reality: an examination of discourse processes in simulated guided walking tours. *British Journal of Educational Technology, 50*(6), 3345–3360. https://doi.org/10.1111/bjet.12738
Qian, M., & Clark, K. R. (2016). Game-based learning and 21st century skills: A review of recent research. *Computers in Human Behavior, 63*, 50–58. https://doi.org/10.1016/j.chb.2016.05.023
Rios, F., Trent, A., & Castañeda, L. V. (2003). Social perspective taking: Advancing empathy and advocating justice. *Equity & Excellence in Education, 36*(1), 5–14. https://doi.org/10.1080/10665680303506
Roberts, J., Lyons, L., Cafaro, F., & Eydt, R. (2014). Interpreting data from within: Supporting human data interaction in museum exhibits through perspective taking. In *Proceedings of the 2014 conference on Interaction design and children* (pp. 7–16).
Ruberg, B. (2018). Queerness and video games: Queer game studies and new perspectives through play. *GLQ: A Journal of Lesbian and Gay Studies, 24*(4), 543–555. https://doi.org/10.1215/10642684-6957940
Ruberg, B., Phillips, A., Pozo, T., Stone, K., & Youngblood, J. (2018). Queerness and video games not gay as in happy: Queer resistance and video games (introduction). *Game Studies, 18*(3).
Shute, V. J., Wang, L., Greiff, S., Zhao, W., & Moore, G. (2016). Measuring problem solving skills via stealth assessment in an engaging video game. *Computers in Human Behavior, 63*, 106–117.
Simons, P. (2018). Paula simons: A new feeling of pride at the university that once fired gay instructor. *Edmonton Journal*. Retrieved from: https://edmontonjournal.com/opinion/columnists/paula-simons-a-new-feeling-of-pride-at-the-university-that-once-fired-gay-instructor.
Spreng, R. N., McKinnon, M. C., Mar, R. A., & Levine, B. (2009). The Toronto Empathy Questionnaire: Scale development and initial validation of a factor-analytic solution to multiple empathy measures. *Journal of Personality Assessment, 91*(1), 62–71. https://doi.org/10.1080/00223890802484381
Staley, S., & Blackburn, M. V. (2023). Troubling emotional discomfort: Teaching and learning queerly in teacher education. *Teaching and Teacher Education, 124*. https://doi.org/10.1016/j.tate.2023.104030
Statistics Canada. (2021a). *A statistical portrait of Canada's diverse LGBTQ2+ communities*. Retrieved from https://www150.statcan.gc.ca/n1/daily-quotidien/210615/dq210615a-eng.htm.
Statistics Canada. (2021b). *Police-reported hate crime in Canada, 2019*. Retrieved from https://www150.statcan.gc.ca/n1/pub/85-002-x/2021001/article/00002-eng.htm.
Statistics Canada. (2022a). *Understanding sex at birth and gender of people in Canada*. Retrieved from: https://www150.statcan.gc.ca/n1/daily-quotidien/220914/dq220914c-eng.htm.
Statistics Canada. (2022b). *The Canadian census: A rich portrait of the country's religious and ethnocultural diversity*. Retrieved from https://www150.statcan.gc.ca/n1/daily-quotidien/221026/dq221026b-eng.htm.
Taub, M., Azevedo, R., Bradbury, A. E., Millar, G. C., & Lester, J. (2018). Using sequence mining to reveal the efficiency in scientific reasoning during STEM learning with a game-based learning environment. *Learning and Instruction, 54*, 93–103, 10.106/j.learninstruc.2017.08.005.
Taylor, C. G., Meyer, E. J., Peter, T., Ristock, J., Short, D., & Campbell, C. (2016). Gaps between beliefs, perceptions, and practices: The Every Teacher Project on LGBTQ-inclusive education in Canadian schools. *Journal of LGBT Youth, 13*(1–2), 112–140.
Todd, A. R., Bodenhausen, G. V., & Galinksy, A. D. (2012). Perspective taking combats the denial of intergroup discrimination. *Journal of Experimental Social Psychology, 48*(3), 738–745. https://doi.org/10.1016/j.jesp.2011.12.011
Todd, A. R., Bodenhausen, G. V., Richeson, J. A., & Galinsky, A. D. (2011). Perspective taking combats automatic expressions of racial bias. *Journal of Personality and Social Psychology, 100*(6), 1027–1042. https://doi.org/10.1037/a0022308
Trilling, B., & Fadel, C. (2009). *21st Century skills, enhanced edition: Learning for life in our times*. John Wiley & Sons.
United States Department of Justice. (2020). *2020 hate crime statistics*. Retrieved from https://www.justice.gov/hatecrimes/hate-crime-statistics.
Valente, M. J., & MacKinnon, D. P. (2017). Comparing models of change to estimate the mediated effect in the pretest–posttest control group design. *Structural Equation Modeling, 24*(3), 428–450. https://doi.org/10.1080/10705511.2016.1274657
van Drie, J., & van Boxtel, C. (2008). Historical reasoning: Towards a framework for analyzing students' reasoning about the past. *Educational Psychology Review, 20*, 87–110. https://doi.org/10.1007/s10648-007-9056-1
Van Laar, E., Van Deursen, A. J., Van Dijk, J. A., & De Haan, J. (2017). The relation between 21st-century skills and digital skills: A systematic literature review. *Computers in Human Behavior, 72*, 577–588. https://doi.org/10.1016/j.chb.2017.03.010
Verkuyten, M., & Thijs, J. (2013). Multicultural education and inter-ethnic attitudes. *European Psychologist, 18*, 179–190. https://doi.org/10.1027/1016-9040/a000152
Virta, A. (2009). Learning to teach history in culturally diverse classrooms. *Intercultural Education, 20*(4), 285–297.
Wang, Y.-W., Davidson, M. M., Yakushko, O. F., Savoy, H. B., Tan, J. A., & Bleier, J. K. (2003). The scale of ethnocultural empathy: Development, validation, and reliability. *Journal of Counseling Psychology, 50*(2), 221–234. https://doi.org/10.1037/0022-0167.50.2.221
Warren, C. A. (2018). Empathy, teacher dispositions, and preparation for culturally responsive pedagogy. *Journal of Teacher Education, 69*(2), 169–183. https://doi.org/10.1177/0022487117712487
Wiggins, R. A., Follo, E. J., & Eberly, M. B. (2007). The impact of a field immersion program on pre-service teachers' attitudes toward teaching in culturally diverse classrooms. *Teaching and Teacher Education, 23*(5), 653–663. https://doi.org/10.1016/j.tate.2007.02.007