

# A systematic review of ‘equity-focused’ game-based learning in the teaching of health staff

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## ABSTRACT

**Background:** An unequal distribution of the social determinants of health drives health inequalities. Existing training fails to communicate the impossible circumstances that disadvantaged groups face. Game-based learning is increasingly used as an innovative method with the potential to enhance health staff’s ability to address health inequalities, but its effectiveness is unknown. Therefore, the aim of this systematic review was to evaluate the effectiveness of ‘equity-focused’ game-based learning in training health staff.

**Study design:** Systematic Review.

**Methods:** Three databases (Ovid Medline, Embase, Web of Science) and a citation search were systematically searched for articles from January 2010 to July 2023, reporting on effectiveness of ‘equity-focused’ game-based learning. Titles and abstracts were screened using eligibility criteria to identify relevant studies. Data was extracted and the ROBINS-I tool was used to assess quality.

**Results:** The search identified 7615 articles, of which thirteen were included involving 2412 healthcare workers. A variety of game-based learning tools were found to have an overall positive effect on motivation, knowledge, attitudes, and engagement of health staff. However, the significance of the results varied depending on specific game context. All included studies were judged to have serious to critical risk of bias.

**Conclusions:** Game-based learning has the potential to improve the effectiveness of ‘equity-focused’ training for health staff. Educators and researchers should further collaborate to expand the tools available and evaluate their effectiveness on long-term clinical practice.

## What this study adds

- This is the first systematic review to evaluate ‘equity-focused’ game-based learning for educating health staff.
- Where traditional education methods fail to convey the impact of social determinants of health, the findings of these studies demonstrate that game-based learning can positively impact participants understanding and attitudes towards health inequalities.

## Implications for policy and practice

- Researchers should formulate guiding principles for ‘equity-focused’ game-based learning.
- Further research should aim to provide conclusive evidence of its efficacy to augment with didactic tools.

## 1. Introduction

The social determinants of health (SDoH) are defined as ‘the non-clinical medical factors that influence health outcomes; the conditions in the environments where people are born, live, learn, work, play, worship, and age that affect a wide range of health, functioning, and quality-of-life outcomes and risks’ [1]. The unequal distribution of these factors drive health inequalities [1]. For example, poor-quality housing in the UK is likely to worsen or cause respiratory and cardiovascular conditions as well as worsen an individual’s mental health [2]. The WHO called for an improved understanding of SDoH across health staff and wider society in 2008 [3]. It is essential that organisations involved in education and training teach staff effectively about the SDoH to address health inequalities [4].

In the UK the General Medical Council’s outcomes for medical graduates, states that ‘newly qualified doctors must be able to apply

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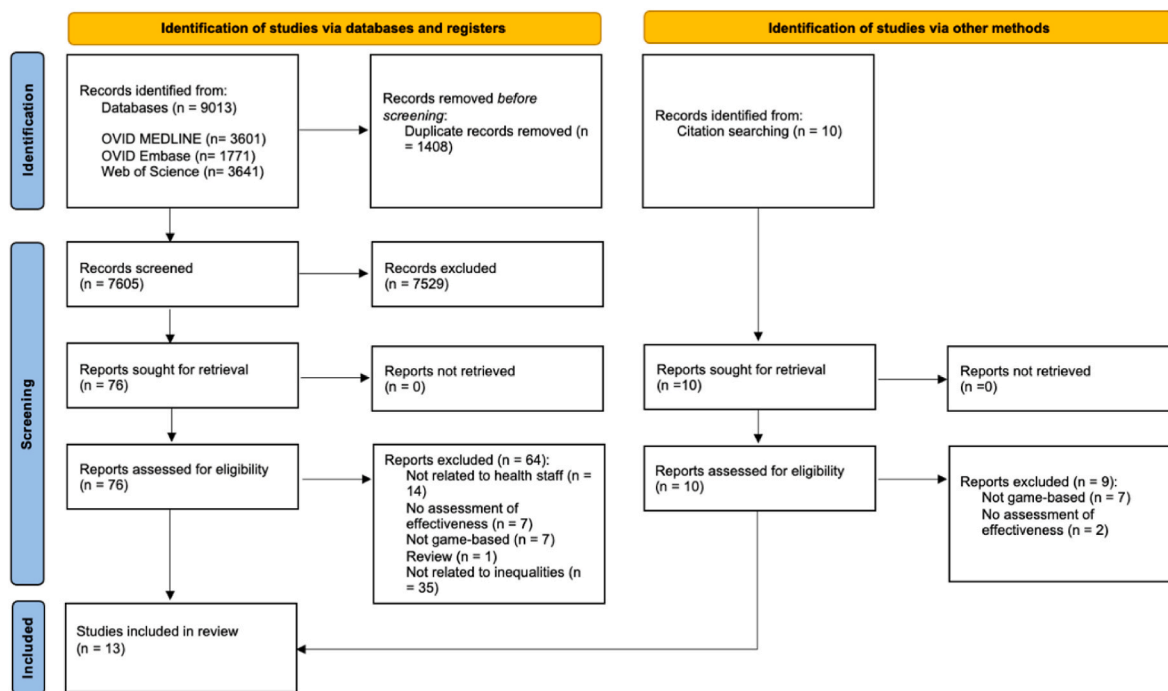


Fig. 1. PRISMA flow diagram.

social science principles, methods and knowledge to medical practice and integrate these into patient care' [5]. Healthcare staff are uniquely positioned as their remit transverses both health and social care. As part of their role, they are required to advocate for disadvantaged groups, however research suggests that health staff can have biases that cause marginalization [6]. Furthermore, evidence suggests that students can lose empathy for these groups as their clinical experience increases [7]. Reinforcement of stereotypes can often lead individuals to have negative opinions towards others who identify differently to them [8].

Many health staff will have completed training in health inequalities and there are several e-learning tools available [9]. However, most of this teaching does not give learners a real-world understanding of the lived experience of people facing disadvantage.

To improve the training of health staff, educators are increasingly using novel approaches for the education of staff [10]. Game-based learning is an innovative pedagogical method that is becoming more popular in health education to improve student engagement, reinforce learning objectives, and teach concepts which are more difficult to learn through traditional teaching methods [10]. Game-based learning is defined as learning facilitated by the use of game principles with the aim of enhancing learning and engagement [10]. This may be through electronic games, board games or workshop-style games. There is growing evidence to suggest that game-based education is associated with effective learning, with improvements seen in knowledge and skills [11].

Serious gaming, defined as gaming used outside of entertainment, in particular can give individuals the opportunity to better understand situations for which they do not have lived experience [12]. For example, it may provide an opportunity for learners to understand the trade-offs individuals must make when living in poverty. It also provides a safe environment to explore topics which may be uncomfortable, such as hierarchical structures within society [13]. Equity-focused game-based learning focuses on educating learners about health inequalities and the impact of the SDoH.

We currently do not know the effectiveness health staff using equity focused game-based. Our aim was to evaluate the effectiveness of 'equity-focussed' game-based learning in training health staff to support educators and policy makers and provide insights into how this dynamic

teaching tool can help staff address health inequalities.

## 2. Methods

A systematic review was conducted and reported according to Preferred Reporting for Systematic Reviews and Meta-analyses (PRISMA) guidance [14]. We focused on international studies which examined game-based learning related to health inequalities in health staff. Health staff included those working in health care, as well as public health or local or national government health departments. We used the MAKE (motivation, attitudes, knowledge and engagement) tool, a validated framework for assessing the efficacy of teaching tools, to measure the outcomes of game-based learning [15].

Ovid Medline, Ovid Embase and Web of Science Core Collection databases were searched from 01/01/2010 to 27/07/2023. Search terms related to game-based learning and inequalities were used to identify relevant articles. Health inequalities terms were adapted from existing terms [16]. Full search terms can be found in appendix 1. For the purposes of this review health staff will encompass a diverse number of roles, including patient-facing positions as well as administrative and leadership positions. This is because we believe that it is important that all staff working within the health field, are aware of the social determinants of health and how it may affect individual's access to health care. Studies were identified based upon the following eligibility criteria (RA).

### Inclusion criteria:

- Articles assessing game-based learning aimed at health staff (defined as any health staff who are involved in a patient's care journey or health-related students (including psychology)),
- Include a component of health equity, as defined by the PROGRESS-Plus categories (a framework used to identify the social determinants that effect health equity) [17],
- Published in/after 2010.

### Exclusion criteria:

- Articles not in English,

**Table 1**  
Study characteristics.

First author, year and country	Aim	PROGRESS-Plus	Population group	Study design	Game-based learning tool	Evaluation
Adams (2019), USA [23]	To examine the impact on empathy and policy action, of using Monopoly to create a simulated environment of economic disparity	Social economic status	Pre-license nursing students (n = 101)	Cross-sectional descriptive methods (2016 - 2017)	Modified Monopoly, board game	Oral debriefing and written reflection
Chen (2015), USA [21]	To evaluate changes in empathy/perceptions and game experiences after use of ageing simulation game	Age	First-year student pharmacists (n = 156)	Single group pre-test and post-test (2014)	Geriatric Medication Game, ageing simulation game	Kiersma-Chen Empathy Scale (KCES) and Jefferson Scale of Empathy - Health Professions Scale (JSE-HPS) for empathy and Aging Simulation Experience Survey (ASES) for perceptions
Feldhacker (2021), USA [35]	To evaluate the impact of an interactive interprofessional education (IPE) game on the SDoH knowledge, attitudes toward IPE and future collaborative practice	Place of residence, social capital, socioeconomic status, culture, education	Health- field students (n = 42)	Mixed-method pilot study within a four-arm randomised controlled trial; pre-test, post-test and one-month follow-up	Strategies for Health, Interactive table-top game	Interprofessional Attitudes Scale (IPAS), knowledge-based test on SDoH and qualitative feedback during gameplay and debriefing
Hershberger (2022), USA [28]	Utilise components of evidence-based prejudice habit breaking interventions, to reduce stereotypes	Ethnicity, language, gender, socioeconomic status	Health professionals (n = 158)	Single group pre-test and post-test	Interactive life-course simulated experience and virtual reality immersive clinical encounter	Survey addressing emotion, expectations, attributions and motivation using likert-type scale
Jirasevijinda (2010), USA [20]	To teach paediatric doctors about the psychosocial aspects of the surrounding community	Social capital, socioeconomic status, culture, place of residence	Paediatric doctors (n = 30)	Single group pre-test and post-test	Bronx Jeopardy!®, quiz competition where given contestants are given clues and must identify the question that correctly identifies the clue	Survey using Likert-type scale, dichotomised into 'agreed' and 'not-agreed'
Mason (2018), Canada [19]	To investigate the uptake and impact of modules with elements of serious gaming, on respondents knowledge about domestic abuse and their preparedness to care for female victims	Gender	Health care providers (n = 912) (August 2007 - August 2016)	Single group pre-test, post-test after each module and three month follow-up post-test	Responding to Domestic Violence in Clinical Settings, competency-base, serious video game with 17 modules	Survey using likert-type scale on competence and knowledge
Olivier (2019), South Africa [24]	To investigate the use of a serious game to enhance empathy and reduce prejudice of students towards persons with disabilities	Disabilities	Psychology university students (n = 83)	Randomised controlled trial; pre-test, post-test and follow-up test	The World of Empa, serious game focussed on the care of a person with disabilities	Empathy quotient (EQ), interpersonal reactivity index (IRI- sub-scales of perspective taking and fantasy plus empathic concern and personal distress) and implicit association test (IAT)
Ong-Flaherty (2017), USA [25]	To create cultural awareness amongst health students		Nursing and clinical psychology students (n = 45)	Qualitative study post-test	BaFa' BaFa', table-top card game	Debriefing session
Pollio (2023), USA [29]	To engage students to address complex needs of clients in primary care (including social determinants of health)		Health staff (n = 56)	Single group pre-test and post-test	Concepts of Primary Care, board game	Survey using five-point Likert rating and qualitative feedback
Rahman (2022), USA [26]	To assess if an online poverty game (SPENT) and computer simulations impacts knowledge and perceptions of SDoH	Socioeconomic status, culture, religion	First-year pharmacy students (n = 132)	Single group pre-test and post-test	SPENT, online poverty simulation game, and computer-simulated clinical scenario activity as part of health classroom activities (other activities included video, quiz and in-class discussion)	Survey using five-point Likert rating

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Table 1 (continued)

First author, year and country	Aim	PROGRESS-Plus	Population group	Study design	Game-based learning tool	Evaluation
Richey Smith (2016), USA [27]	To measure undergraduate health profession students' attitudes toward poverty before and after playing the online game and to determine whether any demographic characteristics ameliorated student responses	Socioeconomic status	Health profession students (n = 306)	Single group pre-test and post-test	SPENT, online poverty simulation game	Undergraduates Perceptions of Poverty Tracking Survey (UPPTS) using a Likert-type scale and qualitative feedback
Sanko (2021), USA [30]	To compare attitudes toward poverty of students participating in a simulation and the poverty table-top simulation game	Socioeconomic status	CAPS, n = 80 (nursing students), Dwell™, n = 212 (nursing and physical therapy students)	Quasi-experiment; single group pre-test and post-test	Dwell™, poverty table-top simulation game or CAPS, immersive simulation	UPPTS using a Likert-type scale and qualitative feedback
Smith (2017), USA [22]	To identify if an online game improves students' attitudes towards those living in poverty, if these changes were retained and to identify if a simulation has an additional benefit.	Socioeconomic status	First year and second year professional phase pharmacy students (n = 99)	Single group pre-test and post-test	SPENT, online poverty game, and CAPS, immersive simulation	UPPTS using a Likert-type scale

- Letters, commentaries or conference abstracts,
- Articles which describe game-based learning but do not have any assessment of the impact.

Duplicates were removed. All titles and abstracts were screened by a single reviewer (using Rayyan) (RA). 10 % were reviewed by a second researcher (LM) to check for systematic errors. Three inconsistencies were resolved by a third researcher (JF). The full text of all articles meeting the eligibility criteria was reviewed.

After a full paper review, articles' citations were hand screened to assess if further papers met the eligibility criteria.

The data was extracted by RA and double checked by a second author, using a proforma including: study characteristics (author(s), year, country, aim, population and study design), description of the equity-focused game-based learning tool used (name, type, evaluation-tool) and outcomes relating to each of the MAKE domains [15]. The Risk of Bias in Non-randomized Studies of Interventions (ROBINS-I) tool was used to assess quality of studies [18]. A narrative synthesis approach was used to interpret the data. A meta-analysis was not undertaken due to insufficient homogenous studies.

No alterations to the research questions, search criteria or methods of data extraction were made throughout the review process.

### 3. Results

The database search identified 9013 articles and after deduplication we screened 7605 articles. We reviewed the full text of 76 articles from the database search and 10 from citation screening. Thirteen studies met the inclusion criteria and were included in the review (see Fig. 1).

Eleven studies took place in the United States of America, as well as one in South Africa and one in Canada (Table 1). A variety of game-based learning tools were used in the articles, with most participants being health students (Table 1). Given the demography of health students, participants tended to be younger females (Table 2). Eight studies examined table-top games, four studies examined electronic games and one study examined both a table-top game and an electronic game. One study examined SPENT, an online poverty simulation game, another study examined Community Action Poverty Simulation (CAPS) and a

further study compared both SPENT and CAPS.

A quality assessment was undertaken for the included studies using the ROBINS-I tool [18] (Table 3). All studies were found to have serious or critical risk of bias. Ten studies used a pre- and post-study design, most without control groups. Only one study compared the findings of the game-based learning tool against a traditional didactic method. The most common source of bias was confounding, as most studies were unable to distinguish between the role of the game-based learning intervention and other confounding factors that influence a change in understanding about equity in healthcare.

The studies were examined using the MAKE framework to evaluate the efficacy of the game-based learning tool (Table 4) [15].

#### 3.1. Motivation

Overall, of the seven studies that reported on motivation, game-based learning was found to have a positive effect on the motivation of health staff. 90.5 % of participants reported a change in their practice after playing a serious video game [19] whereas 40 % of participants reported this change following Bronx Jeopardy! ©<sup>20</sup>. Adams (2019) and Pollio et al. (2023) reported that participants would now consider the SDoH when providing care after playing board games. Two studies, which had simulation components, observed that post-intervention participants were more willing to help older [21] and/or poorer [21, 22] patients. One study reported that participants expressed a desire to advocate for their patients [23] and another described that the intervention had encouraged them to learn more about SdoH [20]. These findings suggest that game-based learning can encourage health staff to provide equitable care.

#### 3.2. Attitudes

Reported results suggest that game-based learning can increase participants' empathy to varying degrees [21–27]. Sanko et al. (2021) found that the change in empathy after the table-top simulation was greater than after the immersive simulation. However, only one study by Smith et al. (2017), reviewed whether the change was sustained over time. They found that the increase in empathy was not statistically

**Table 2**  
Study population characteristics.

First author, year and country	Study Population characteristics
Adams (2019), USA [23]	The average age was 23 years with most students female (79.2 %) and white (52.4 %).
Chen (2015), USA [21]	60.9 % female and 66.7 % between ages of 19 and 21.
Feldhacker (2021), USA [35]	21 participants were undergraduates, 21 participants were graduates.
Hershberger (2022), USA [28]	Participants had an average age of 32.6 years, with the majority female (75.8 %) and white (77.2 %). 64.9 % were clinical personnel.
Jirasevijinda (2010), USA [20]	Two-thirds were first-year trainees and 54 % were male.
Mason (2018), Canada [19]	Younger registrants were more likely to continue into the program than older age groups. More registrants that were referred by a clinical educator continued into the program compared to registrants who were not recruited formally. Nursing students were more likely to complete a higher average number of modules. From 2007 to 2013, a significantly higher proportion of female registrants continued on into the programme, however from 2014 to 2016 a significantly higher proportion of male registrants continued on into the programme.
Olivier (2019), South Africa [24]	Majority of participants were female (78 %), between 18 and 21 years (39 %) and Caucasian (60 %). Three participants had disabilities themselves with 84 % having had no experience working with disabled persons.
Ong-Flaherty (2017), USA [25]	Participants included 34 graduate nursing students and 11 doctoral clinical psychology students. The age range was between 22 and 44. A total of 9 males and 35 females were included (1 declined to give demographic information).
Pollio (2023), USA [29]	Participants included 4 nursing students, 5 faculty members and 10 clinical mentors.
Rahman (2022), USA [26]	The average age of participants was 21 years and 10 % of the students were from minority ethnicities.
Richey Smith (2016), USA [27]	Participants included 36 physician assistants, 30 communication science disorder students, 113 pre-professional phase pharmacy students and 113 professional phase pharmacy students.
Sanko (2021), USA [30]	Participants aged between 18 and 55 years, mostly white (72 %). 74 % of participants had personal experience with poverty. Most people did not worry about their social determinants of health.
Smith (2017), USA [22]	Participants included 66 women and 33 men.

significant [22].

Studies observed that game-based learning can help to reduce negative stereotypes, and could help to encourage a more non-judgemental approach to care [19,20,28].

One study reported that participants in the intervention had greater understanding of the frustration that can be caused by a lower socio-economic position [23], or being discriminated against because of age [21]. Some studies did report negative attitudes after the game-based learning interventions [27,28], for example participants stated they felt aggravated at the additional burden when reviewing a deprived patient. However, this did not appear to change individuals' perceptions of the care they would provide.

Generally, the studies suggest that game-based learning interventions can improve understanding and foster empathy amongst health staff.

### 3.3. Knowledge

The majority of studies reported knowledge as part of their assessment of the effectiveness of the game-based learning tool. The significance of these changes varied depending on the specific game and context. Most studies reported an increase in participants' knowledge of the SdoH post-intervention [20,21,23,25,28–30]. These studies

included a mixture of game-based learning interventions. Both studies investigating the use of SPENT also saw an increase in participants' knowledge [26,27], however, Rahman et al. (2022) saw a particularly small increase in knowledge, indicated by an increase in 0.2 points in the post-test Likert-type score.

Only 10.2 % of participants completed a serious video game about domestic violence [19] with only participants who completed both the game and didactic module reporting a statistically significant increase in knowledge score post-intervention.

### 3.4. Engagement

Eight of the thirteen articles reported data on participants' engagement. Competitors found a variety of game-based learning activities consistently enjoyable and effective [19,20,26,28,29]. SPENT received slightly more positive feedback than CAPS in Smith et al. (2017). While most participants responded positively to SPENT in Richey Smith et al. (2016), some negative comments suggested that alternative methods may be more effective to teach about poverty. Specifics about how the game-based learning tool can engage participants were discussed in Oliver et al. (2019), where a small increase in an individuals' ability to transpose themselves into a disabled person's situation was seen.

## 4. Discussion

This is the first systematic review aimed at examining the effectiveness of 'equity-focused' game-based learning in health staff. The findings suggest that game-based learning tools generally had a positive impact on the motivation of health staff, improving empathy and knowledge. Importantly, the size of the changes depended greatly on the specific game, participants, and context. The interventions were generally found to be engaging, suggesting that 'equity-focused' game-based learning may be a more innovative approach to educating health staff. However, the significance of these results are difficult to ascertain due to less rigorous study designs.

The use of games can help individuals experience different simulated circumstances [31]. Due to the small number of studies included in this review, it is difficult to appreciate which specific teaching tool is most effective. However, the majority of game-based learning tools in this review contain an element of role-playing or simulation. This pedagogical approach allows individuals a safe environment to explore others' situations, highlighting the disadvantages others might experience. Traditional didactic methods, particularly in health related subjects, are associated with superficial learning which rarely translates into sustained behaviour change [32]. The most effective teaching is active and focuses on the learners' activities and cognitive processes involved, rather than tasks set by the teacher [33]. This review demonstrates that game-based learning tools are an appropriate method to teach health equity through active learning. The difficulty of the games was not considered in studies. Learning activities that optimally challenge participants and recognise when they are struggling have resulted in better learning outcomes [34]. The level of difficulty is subjective so can vary between participants. However, this aspect of game-based learning tools should be considered when designing and delivering an intervention.

When comparing a table-top simulation to an immersive simulation, Sanko et al. (2021) found that the table-top game provided a greater increase in empathy. A mixture of game and didactic models were found to be more effective at improving knowledge [35]. This suggests that further research is required to help inform equity-focused game-based learning aimed at targeting all aspects of the MAKE framework [15]. SPENT and CAPS are both game-based learning tools that have accumulated evidence in this field; given their reported positive effects on attitudes and knowledge, the tools could be used as a guide for educators wanting to improve the teaching of health disparities.

Only one game-based learning tool, a board-game [23], encouraged

**Table 3**  
Study Quality Assessment (ROBINS-I tool).

Study	Bias due to confounding	Bias due to selection of participants into study	Bias in classification of interventions	Bias due to deviations from intended interventions	Bias due to missing data	Bias in measurement of outcomes	Bias in selection of reported result
Adams (2019), USA [23]	Critical	Low	Low	Critical	Low	Critical	Low
Chen (2015), USA [21]	Critical	Low	Low	Serious	Moderate	Serious	Low
Feldhacker (2021), USA [35]	Serious	Low	Low	Critical	Low	Critical	Low
Hershberger (2022), USA [28]	Critical	Low	Low	Serious	Moderate	Serious	Low
Jirasevijinda (2010), USA [20]	Critical	Low	Low	Serious	Low	Serious	Low
Mason (2018), Canada [19]	Critical	Low	Low	Serious	Serious	Serious	Low
Olivier (2019), South Africa [24]	Serious	Low	Low	Serious	Low	Serious	Low
Ong-Flaherty (2017), USA [25]	Critical	No information	Low	Critical	Low	Critical	Low
Pollio (2023), USA [29]	Critical	Moderate	Low	Serious	Low	Serious	Low
Rahman (2022), USA [26]	Critical	Low	Low	Critical	Low	Critical	Low
Richey Smith (2016), USA [27]	Critical	No information	Low	Critical	Low	Critical	Low
Sanko (2021), USA [30]	Critical	Moderate	Low	Serious	Low	Serious	Low
Smith (2017), USA [22]	Critical	Low	Low	Serious	Low	Serious	Low

participants to advocate on a policy level for disadvantaged individuals. Game-based interventions can target policy action through encouraging participants to challenge existing social narratives, and facilitate change on behalf of their patients.

Some of the studies included an interprofessional aspect [25,29,30,35], allowing for colleagues to work in partnership through the interventions. Interprofessional learning has been shown to encourage participants to consider differing opinions and bridge gaps in knowledge [36]. The importance of working together to address patient needs was a theme highlighted in Feldhacker et al. (2021). This suggests interprofessional game-based learning is an effective tool to encourage collaborative working and thus promotes better patient outcomes.

There was little discussion of any previous teaching on SDoH participants had received prior to the intervention. Similarly, it was not detailed whether participants had previous experience treating patients from varied socio-economic backgrounds. Both of these factors may impact the outcome of game-based learning tools. Only two studies [24,35] compared game-based learning tools to traditional didactic teaching methods. It is difficult to attribute the reported effects to the interventions without control groups. Further research is required to assess the specific impact of game-based learning.

Empathy is difficult to assess in comparison to the acquisition of knowledge or skill, especially given that definitions of empathy can vary throughout literature impacting its assessment. Only some studies used validated scales to measure empathy [21,22,24,27,30]. Most of the assessment tools used in the studies included self-reported components, some used in group discussions, which only assess personal perception. Self-reported measures are open to biases, including social desirability bias [37]. Mixed methods approaches may be especially well suited to assess challenging themes, such as empathy. Careful consideration of the study design and standardisation of the assessments would allow researchers to better understand the outcomes of game-based learning tools.

Only one study [22] looked at the sustained changes post the intervention, therefore it is unclear if the tools provide a long-term effect. No study looked at any changes in clinical practice after the intervention. Given that evidence suggests that empathy declines as students' clinical

experience increases [38], it would be useful to assess if the transfer of knowledge changes students' practice in a longitudinal study. It may be that teaching related to inequalities should be repeated throughout a health staff member's career. The technique of spaced practice is produces better learning [37], therefore repeated teaching could reinforce positive attitudes towards patients.

#### 4.1. Strengths and limitations

This is the first review which has examined equity-focused game-based learning. We used a rigorous search and selection criteria include diverse interventions. A robust risk of bias assessment was conducted which highlighted generally low quality data on the topic. Given the nature of the game-based interventions, a randomised controlled trial producing high quality data would be difficult to achieve. The study designs examined in this review, mainly pre- and post-test designs, contribute to the low-quality data. This needs to be considered when examining the credibility of the findings drawn from this review. Studies tended to have small sample sizes, which limited the depth of the analysis. Given that the participant pool was generally drawn from health students, the conclusions have limited generability to other health staff. We have only reported the published game-based learning tools, but it is likely that game-based learning is currently being used in a range of settings which it has not been evaluated or published.

#### 4.2. Impacts on research and policy

Game-based learning provides a key opportunity for educators to develop tools which allow learners to better understand the lived experience. Multidisciplinary collaboration is needed between game developers, educators, health inequalities experts and communities to innovatively develop new games. Funders of research and educational resources should create opportunities and incentives for these collaborations. Importantly the lived experience of individuals and communities should be reflected in any game development.

Educators and policymakers also need to consider how game-based learning can be augmented with traditional forms of training. Based

**Table 4**  
Main findings.

First author, year and country	Summary of study	Main results reporting the effectiveness of 'equity-focused' game-based learning in the teaching of health care professionals using the MAKE [15]
<b>Adams (2019), USA [23]</b>	A cross-sectional descriptive methods study using a modified Monopoly game, for pre-license nursing students, to examine impact of economic disparity on empathy and policy action	<b>M:</b> Students described how they will consider patients' contextual factors when providing patient care as a result of playing the game. Students also stated how they felt more empowered and want to become advocates for patients, but need more confidence to do so. <b>A:</b> Emotional responses of 'disappointment, frustration and anger' towards a players' poor economic position in the game were revealed. Students also described empathy towards individuals who have poor economic positions. <b>K:</b> Students stated an increase in awareness of inequalities and understanding of the experience of disadvantaged groups. <b>E:</b> Not reported.
<b>Chen (2015), USA [21]</b>	A single group pre-test and post-test study using an ageing simulation game, for student pharmacists to evaluate the changes in empathy/perceptions and game experiences	<b>M:</b> In the ASES post-test students agreed that they plan to provide more assistance and be more patient towards older adults in the future (88 % strongly agree with the statement, 76 % agreed with the statement). <b>A:</b> Empathy changed with both KCES (82(8) to 86(9), $p < 0.001$ ) and JSE-HPS increasing (105(11) to 109 (15), $p < 0.001$ ). The most common emotions that students felt older adults may experience were frustration, annoyance and impatience. <b>K:</b> Students' understanding of patients' experiences improved significantly for 9 of 13 items on ASES. <b>E:</b> Not reported.
<b>Feldhacker (2021), USA [35]</b>	A mixed method pilot study within a four-arm RCT, pre-test, post-test and one-month follow-up study. Intervention consisted of an interactive interprofessional education table-top game, for health-field students, to evaluate the impact on SDoH knowledge.	<b>M:</b> Not reported. <b>A:</b> Common equity focused themes from the debrief included 1) 'the importance of team working to address patient and community needs' 2) 'allied health professionals can help address patient and community needs' 3) 'how access to resources plays a key role in a person's ability to access health services'. <b>K:</b> There was no difference between groups' knowledge of SDoH at baseline ( $p = 0.811$ ). There was no improvement in participants' knowledge of SDoH ( $F(1.53, 53.52) = 2.63, p = 0.095$ ) across all groups. To get a

**Table 4 (continued)**

First author, year and country	Summary of study	Main results reporting the effectiveness of 'equity-focused' game-based learning in the teaching of health care professionals using the MAKE [15]
<b>Hershberger (2022), USA [28]</b>	A single group pre-test and post-test study using an interactive game for health professionals aimed at reducing stereotypes	post-experience score the post-test and follow-up scores were averaged. There was only a statistically significant increase in the post-experience score for the group that participated in the combined game and didactic module ( $M = -0.82, SD = 1.16$ ); $t(10) = -2.33, p = 0.04$ . <b>E:</b> Not reported. <b>M:</b> Not reported. <b>A:</b> Participants responded that the training experience will make them a more understanding health professional and will help them to reduce any negative biases. Respondents had more feelings of compassion towards the patient post-simulation ( $SMD = -0.263, p = 0.001$ ), but also more frustration at potentially seeing the simulated patient next ( $SMD = -0.157, p = 0.05$ ). However, participants were less likely to indicate a preference for seeing a different patient for follow-up rather than the simulated patient ( $SMD = 0.213, p = 0.008$ ). There was a decrease in expectation about the difficulty of encountering the simulated patient ( $SMD = 0.213, p = 0.009$ ). For the clinical personnel, there was an increase in compassion ( $SMD = -0.290, p = 0.004$ ) and decrease in the level of difficulty expected for the patient encounter ( $SMD = 0.245, p = 0.02$ ). <b>K:</b> The amount an individual was seen to be responsible for their situation decreased post simulation ( $SMD = 0.316, p = 0.0001$ ) and an increase in acknowledging circumstances are out of one's control ( $SMD = -0.309, p = 0.0001$ ), representing some decreased expression of the fundamental attribution error. <b>E:</b> Participants responded that it was an effective learning platform. <b>M:</b> All of the respondents reported the Bronx Jeopardy! © format stimulated interest in learning more about the community. 40 % stated the game would change their practice. <b>A:</b> 96.6 % reported that training sessions helped them to dispel negative stereotypes.
<b>Jirasevijinda (2010), USA [20]</b>	A single group pre-test and post-test study using Bronx Jeopardy! © for paediatric doctors aimed at teaching psychosocial aspects of the surround community	

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Table 4 (continued)

First author, year and country	Summary of study	Main results reporting the effectiveness of 'equity-focused' game-based learning in the teaching of health care professionals using the MAKE [15]
<b>Mason (2018), Canada [19]</b>	A single group pre-test, post-test and follow-up study using an online serious game for health care providers to aimed at improving knowledge of domestic violence	<p><b>K:</b> 83.3 % reported that information gained during the game was new to them. All felt this new information would help them with patient care. 96.6 % of respondents reported that the game helped them understand the diversity of the community and raised awareness of the challenges faced by the community. All felt that Bronx Jeopardy!© format will help them retain information.</p> <p><b>E:</b> All respondents reported it a fun and effective way to learn and will help them retain information.</p> <p><b>M:</b> 90.5 % of participants that answered the open-ended question gave examples of changes to their practice after completion of the modules. Most frequently stated changes included: asking about DV and listening more carefully.</p> <p><b>A:</b> Open-ended question responses included that participants would be 'nonjudgmental in response to disclosures of abuse' and 'more aware'.</p> <p><b>K:</b> 10.2 % (912/8939) finished the programme and passed quizzes testing knowledge after each of the 17 modules.</p> <p><b>E:</b> Positive responses ranged from 95.8 % stated that style was effective and information relevant to 97.3 % stated that information was credible. Open-ended question feedback was almost universally positive with comments that the modules were 'easy to follow', 'interesting', 'engaging' and its interactive nature was a strength.</p>
<b>Olivier (2019), South Africa [24]</b>	A randomised controlled trial; pre-test, post-test and follow-up study using a serious game (The World of Empa) for psychology university students aimed at enhancing empathy and reduce prejudice towards persons with disabilities	<p><b>M:</b> Not reported.</p> <p><b>A:</b> After playing The World of Empa there, a slight positive short-term effect on prejudice and sub-scale measurements of empathy were reported. However, changes seem to occur in the control groups rather than in the experimental group, indicating that the serious game may prevent a slight decline in empathy.</p> <p><b>K:</b> Not reported.</p> <p><b>E:</b> A small increase in the sub-scale of fantasy in the immediate post-test of the experimental group was noted, highlighting that the</p>

Table 4 (continued)

First author, year and country	Summary of study	Main results reporting the effectiveness of 'equity-focused' game-based learning in the teaching of health care professionals using the MAKE [15]
<b>Ong-Flaherty (2017), USA [25]</b>	A qualitative post-test study using a table-top card game (BaFa' BaFa') to create cultural awareness in health students	<p>game can improve respondents' ability to transpose themselves into a disabled persons' situation.</p> <p><b>M:</b> Not reported.</p> <p><b>A:</b> Students described the importance of appreciating others' culture in health care and identified how empathy can improve communication and patient-centred care.</p> <p><b>K:</b> The participants acknowledged the importance of culture and the influence it has on how individuals believe, think and behave post-game. Participants also described the theme of 'insider/ outsider' to explain the inclusion and exclusion of individuals from a societal group. Participants explain that they learnt about cultural diversity and became more aware of their own cultural differences. Students reflected on how they appreciate that their own knowledge of culture was limited.</p> <p><b>E:</b> Not reported.</p>
<b>Pollio (2023), USA [29]</b>	A single group pre-test and post-test study using a board game (Concepts of Primary Care) for health staff aimed at engaging students to address social determinants of health	<p><b>M:</b> Qualitative feedback stating respondents 'will use knowledge by intentionally thinking of SDoH'.</p> <p><b>A:</b> Not reported.</p> <p><b>K:</b> Respondents post-test were more confident in understanding their role of addressing SDoH. Respondents had more understanding of resiliency strategies after the game. Students noted games as being beneficial to their learning.</p> <p><b>E:</b> Respondents enjoyed playing the game. Qualitative feedback stating respondents 'enjoyed the learning experience'.</p>
<b>Rahman (2022), USA [26]</b>	A single group pre-test and post-test study using an online poverty game (SPENT) and computer simulations for pharmacy students aimed at assessing impact on knowledge and perceptions of SDoH	<p><b>M:</b> Not reported.</p> <p><b>A:</b> Thematic analysis showed that 42 % of students learnt to be more empathic towards caring for patients with SDoH.</p> <p><b>K:</b> The intervention was perceived to be a useful teaching tool and increased their understanding of SDoH. Thematic analysis showed that 18 % of students learnt about culture, 15 % about socioeconomic factors and 4 % about education. 47 % students felt the overall methods were useful, 27 % students found the simulation specifically useful and 27 %</p>

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Table 4 (continued)

First author, year and country	Summary of study	Main results reporting the effectiveness of 'equity-focused' game-based learning in the teaching of health care professionals using the MAKE [15]
<b>Richey Smith (2016), USA [27]</b>	Single group pre-test and post-test study using an online poverty game (SPENT) for health students aimed at impacting attitudes towards poverty	<p>the online poverty game. Only a small increase in score was seen in pre- and post-assessment quiz analysis, 2.31 (SD 0.93) to 2.51 (SD 0.89), however as part of a combined teaching programme, unable to assess what aspect had an impact on knowledge.</p> <p><b>E:</b> Thematic analysis of comments showed that students enjoyed teaching tools.</p> <p><b>M:</b> Not reported.</p> <p><b>A:</b> On average the UPPTS score increased by 4.1 points post-intervention (t 305 = -8.03, p&lt;0.0005). There was a significant increase (t 305 = -8.03, p&lt;0.0005) in empathy, across all demographic variables. Female participants expressed more empathy than male participants. Income did not affect students' attitudes. Those who started with a less empathetic score generally had a higher absolute change in score. Four participants made negative comments about people living in poverty. However, no participants felt that they were less comfortable interacting with people in poverty after playing the game.</p> <p><b>K:</b> 60.7 % stated that their comfort level at caring for patients in poverty had increased, with 39.3 % responding that their comfort level had not changed. Males were marginally less positive than their female peers (53.1 % vs 68.2, Chi-square = 5.14, p = 0.023). Individuals from urban areas were slightly less likely to report a change in comfort level than those from suburban or rural areas (Chi-square = 3.88, p = 0.049).</p> <p><b>E:</b> The game was described positively by 52 %, with the most common phrase being "eye opening" (11.5 %). There were no significant differences among demographics. Students who felt they already had a good knowledge about poverty or felt that the simulation was unrealistic, did not describe explicitly positive themes. The most negative of the statements indicated that there might be better ways to learn about poverty.</p>

Table 4 (continued)

First author, year and country	Summary of study	Main results reporting the effectiveness of 'equity-focused' game-based learning in the teaching of health care professionals using the MAKE [15]
<b>Sanko (2021), USA [30]</b>	Quasi-experiment; single group pre-test and post-test study using CAPS and the poverty table-top simulation (Dwell™) for students aimed at changing attitudes towards poverty	<p>Respondents described that the game would be particularly useful for those becoming health staff. A neutral theme expressed was that some participants felt the experience was better suited for inexperienced or less sympathetic peers rather than themselves.</p> <p><b>M:</b> Dwell™ increased students' willingness to help poorer individuals (p = 0.008, η2 = 0.058).</p> <p><b>A:</b> Using MANOVA tests, there was no overall change in attitude after either of the simulations. Sub-scale analyses revealed there was a significant increase in participants' empathy towards those living in poverty after playing Dwell™ (p = 0.039, η2 = 0.039). Respondents commented on how both activities made them 'more understanding, compassionate, and more empathetic'.</p> <p><b>K:</b> Participants responded that they had learnt about the struggles of poverty.</p> <p><b>E:</b> Not reported.</p>
<b>Smith (2017), USA [22]</b>	Single group pre-test and post-test study using an online poverty game (SPENT) and Community Action Poverty Simulation (CAPS) for pharmacy students aimed at improving students' attitudes towards those living in poverty	<p><b>M:</b> There was a difference between those who reported wanting to help those in poverty compared to those who indicated the intervention had no impact (p &lt;0.001) following both SPENT and CAPS. Following SPENT there was no significant difference by gender in those willing to help. Following CAPS there was a statistically significant increase in females wanting to help over male students.</p> <p><b>A:</b> An increase in UPPTS after playing SPENT (p = 0.046) was seen. The increase was sustained over an approximately 9 month period but was not significant (p = 0.423). There was also an increase in UPPTS after CAPS (p = 0.001). There was an overall increase in the score of the both interventions (p &lt; 0.001). There was no significant difference between genders across either intervention.</p> <p><b>K:</b> Not reported.</p> <p><b>E:</b> 50.5 % of students indicated that SPENT was 'worthwhile' and 28.3 % felt it was 'very worthwhile'. 2 % stated that it was 'not worthwhile'. For CAPS, 7.1 % felt it was 'not worthwhile'</p>

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Table 4 (continued)

First author, year and country	Summary of study	Main results reporting the effectiveness of 'equity-focused' game-based learning in the teaching of health care professionals using the MAKE [15]
		whereas 39.5 % stated it was worthwhile and 23.2 % indicated it was very worthwhile.

on our review, it appears that game-based learning is likely to be effective at improving motivation and engagement but the effect on participants' attitudes and knowledge varies. This suggests that other forms of learning may be more useful at targeting these pedagogical domains. This review is unable to draw conclusions about which groups of health staff are more receptive to game-based learning. The style of game-based learning should be tailored to different audience, including undergraduate health students, postgraduate trainees and established decision makers.

Future research should focus on the science and theory of game-based learning, rather than individual technologies which are likely to short-lived. Researchers should build an understanding of the guiding principles needed to communicate the realities of disadvantage.

While game-based learning can provide a deeper understanding of the communities' health staff serve, it is important that educational tools align with wider initiatives to increase representation within the work force. This will help to ensure that the diversity of health staff mirrors the patient population, contributing to improving health staff's understanding of health inequities.

## 5. Conclusion

We found that 'equity-focused' game-based learning tools have the potential to have a positive impact on staff with improvements in attitudes, knowledge, motivation and engagement of health staff. However, further robust research is required to capture the learning from interventions, as well as to understand how these tools may affect clinical practice in the long-term.

## Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

## Acknowledgements

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## Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.puhip.2023.100462>.

## Appendix 1. Search terms adapted from Prady et al. (2018)

Medline:

- 1 Residence Characteristics/or Environment design/or exp Marital status/or neighbo?rhood\*.mp. or residential environment\*.mp. or rural\*.mp. or inner?city.mp. or housing instability.mp. or

housing insecurity.mp. or housing strain.mp. or housing security.mp. or mortgage problems.mp. or foreclosure.mp. or eviction\*.mp. or housing loss.mp. or home repossession\*.mp. or home ownership.mp. or (repossess\* adj3 hous\*).mp. or (repossess\* adj3 propert\*).mp. or mortgage delinquency.mp. or mortgage arrears.mp. or mortgage debt\*.mp. or overcrowding.mp. or (living adj1 (outside or inside or near\* or adjacent)).mp. or (household adj2 size).mp. or (marital status or marriage status).mp. or (widow\* or cohabit\* or divorce\* or single parent\* or live\* alone).mp.

- 2 Cultural Deprivation/or Acculturation/or Culture/or Cross-Cultural Comparison/or Cultural Characteristics/or Cultural Diversity/or Language/or "Transients and Migrants"/or exp "Emigrants and Immigrants"/or Minority groups/or Minority health/or Prejudice/or Racism/or Xenophobia/or Social Discrimination/or exp Race Relations/or exp Ethnic Groups/or exp Continental Population Groups/or Refugees/or minorit\*.mp. or migration background.mp. or racial.mp. or racism.mp. or ethnology.mp. or race.mp. or ethnic\*.mp. or non?English.mp. or language other than.mp. or latino\*.mp. or latina\*.mp. or hispanic\*.mp. or whites.mp. or caucasian\*.mp. or non?white.mp. or Torres Strait Islander.mp. or aboriginal.mp. or native american.mp. or inuit.mp. or eskimo.mp. or first nation\*.mp. or indigenous.mp. or english as a second language.mp. or foreign language.mp.
- 3 Occupations/or Unemployment/or occupations.mp. or unemployment.mp.
- 4 exp Gender Identity/or Women's Health/or gender differences.mp. or (sex disparit\* or sex difference?).mp. or gender identity.mp. or sex role.mp. or wom#n\* role?mp. or m#n\* role?mp. or gender\* role?mp. or servicewomen.mp. or Sex factors/
- 5 exp Educational status/or Education/or Schooling.mp. or educational status.mp. or (education\* adj2 level?).mp. or ((higher or better or worse or less) adj educated).mp. or ((higher or better or worse or less) adj level? of education).mp.
- 6 Religion/or religi\*.mp.
- 7 Social determinants of Health/or Psychosocial Deprivation/or Sociological Factors/or Working Poor/or Hierarchy, Social/or disparit\*.mp. or inequalit\*.mp. or inequit\*.mp. or equity.mp. or deprivation.mp. or gini.mp. or concentration index.mp. or Socioeconomic Factors/or Social Welfare/or exp Social Class/or exp Poverty/or Income/or Social class\*.mp. or social determinants.mp. or social status.mp. or social position.mp. or social background.mp. or social circumstance\*.mp. or socio-economic.mp. or socioeconomic.mp. or sociodemographic.mp. or socio-demographic.mp. or SES.mp. or disadvantaged.mp. or impoverished.mp. or poverty.mp. or economic level.mp. or assets index.mp. or income\*.mp.
- 8 Social Stigma/or social capital/or Social Control, Informal/or exp Social Support/or exp Social Environment/or Trust/or Social conditions/or Social isolation/or Social marginalization/or Anomie/or social participation/or social exclusion.mp. or (social adj (capital or cohes\* or organis\* or organiz\*).mp. or (community adj3 (cohes\* or participa\*).mp. or ((neighborhood or neighborhood) adj cohes\*).mp. or social relationships.mp. or social network\*.mp. or collective efficacy.mp. or civil society.mp. or informal social control.mp. or neighbo\*rhood disorder.mp. or social disorgani?ation.mp. or anomie.mp. or social support.mp. or social participation.mp. or trust.mp. or emotional support.mp. or psychosocial support.mp. or community capital.mp. or neighbo\*rhood cohesion.mp. or social influence.mp. or (soci\*-context\* or soci\*-context\*).mp.
- 9 Health Status Disparities/or Health Services Accessibility/or Health Equity/or health\*care disparit\*.mp. or health care disparit\*.mp. or health status disparit\*.mp. or health disparit\*.mp. or health inequalit\*.mp. or health inequit\*.mp. or medically underserved.mp.

- 10 exp Health Status Disparities/or exp Healthcare Disparities/or exp Health Services Accessibility/or exp health equity/or (Medically underserved or disparit\* or ((inequal\* or equity or equal\*) adj3 access\*) or "private health insurance" or private insurance or public insurance or government insurance or commercial insurance or insurance status).ti,ab,kw,kf. or ((health\* or health\*care) adj3 (disparit\* or equal\* or unequal or inequalit\* or equit\* or inequit\* or access\* or inaccess\* or gap\* or gradient\* or variation\* or disadvantage\*).ti,ab,kw,kf. or ((racial or ethnic\* or gender\* or sex) and (minorit\* or differ\* or disparit\*).ti,ab,kw,kf. or ((high\* or low\*) adj2 (educat\* or income\*).ti,ab,kw,kf.
- 11 or/1-10 2745348
- 12 exp Games, Experimental/or exp video games/or (serious gam\* or serious play\* or videogame\* or video gam\* or gamif\* or gameplay\* or gamelike\* or gamebased or gaming or game\$1 or gamer\*).ti,ab,kw,kf.
- 13 exp Vocational Education/or exp Education, Graduate/or exp Education, Medical, Continuing/or exp Health Education/or exp Education, Medical/or exp Education/or exp Education, Medical, Graduate/or exp Education, Nursing/or exp Interprofessional Education/or exp Education, Nursing, Graduate/or exp Education, Continuing/or exp Teaching/or exp Teaching Materials/or exp Learning/
- 14 (educat\* or train\* or teach\* or learn\*).ti,ab,kw,kf.
- 15 13 or 14
- 16 11 and 12 and 15
- 17 limit 16 to yr = "2010 -Current"
- Embase:
- 1 demography/or environmental planning/or marriage/or divorce/or cohabitation/or widow/or exp "single (marital status)/or neighbo?rhood\*.mp. or residential environment\*.mp. or rural\*.mp. or inner?city.mp. or housing instability.mp. or housing insecurity.mp. or housing strain.mp. or housing security.mp. or mortgage problems.mp. or foreclosure.mp. or eviction\*.mp. or housing loss.mp. or home repossession\*.mp. or home ownership.mp. or (repossess\* adj3 hous\*).mp. or (repossess\* adj3 propert\*).mp. or mortgage delinquency.mp. or mortgage arrears.mp. or mortgage debt\*.mp. or overcrowding.mp. or (living adj1 (outside or inside or near\* or adjacent)).mp. or (household adj2 size).mp. or (marital status or marriage status).mp. or (widow\* or cohabit\* or divorce\* or single parent\* or live\* alone).mp.
- 2 exp cultural deprivation/or cultural factor/or cultural anthropology/or cultural diversity/or exp migrant/or minority group/or minority health/or prejudice/or exp social discrimination/or exp race relation/or exp ethnic group/or exp ancestry group/or exp refugee/or minorit\*.mp. or migration background.mp. or racial.mp. or racism.mp. or ethnology.mp. or race.mp. or ethnic\*.mp. or non?English.mp. or language other than.mp. or latino\*.mp. or latina\*.mp. or hispanic\*.mp. or whites.mp. or caucasian\*.mp. or non?white.mp. or Torres Strait Islander.mp. or aboriginal.mp. or native american.mp. or inuit.mp. or eskimo.mp. or first nation\*.mp. or indigenous.mp. or english as a second language.mp. or foreign language.mp.
- 3 exp employment status/or job characteristics/or occupations.mp. or unemployment.mp.
- 4 exp gender identity/or women's health/or sex difference/or (sex disparit\* or sex difference?).mp. or gender identity.mp. or sex role.mp. or wom#n\* role?mp. or m#n\* role?mp. or gender\* role?mp. or servicewomen.mp.
- 5 exp educational status/or schooling.mp. or educational status.mp. or (education\* adj2 level?).mp. or ((higher or better or worse or less) adj educated).mp. or ((higher or better or worse or less) adj level? of education).mp.
- 6 religion/or religi\*.mp.
- 7 "social determinants of health"/or social aspect/or working poor/or or exp social hierarchy/or socioeconomics/or disparit\*.mp. or inequalit\*.mp. or inequit\*.mp. or equity.mp. or deprivation.mp. or gini.mp. or concentration index.mp. or social welfare/or social class/or poverty/or social status/or social background/or social class\*.mp. or social determinants.mp. or social status.mp. or social position.mp.
- 8 (social background or social circumstance\* or socio-economic or socioeconomic or sociodemographic or socio-demographic or SES or disadvantaged or impoverished or poverty or economic level or assets index or income\*).mp.
- 9 exp social isolation/or social capital/or social stigma/or social support/or social environment/or trust/or exp social exclusion/or anomie/or social participation/or social exclusion.mp. or (social adj (capital or cohes\* or organis\* or organiz\*).mp. or (community adj3 (cohes\* or participa\*).mp. or ((neighborhood or neighborhood) adj cohes\*).mp. or social relationships.mp. or social network\*.mp. or collective efficacy.mp. or civil society.mp. or informal social control.mp. or neighbo\*rhood disorder.mp. or social disorgani?ation.mp. or anomie.mp. or social support.mp. or social participation.mp. or trust.mp. or emotional support.mp. or psychosocial support.mp. or community capital.mp. or neighbo\*rhood cohesion.mp. or social influence.mp. or (soci\*-context\* or soci\*-context\*).mp.
- 10 health disparity/or health equity/or health care access/or health\*care disparit\*.mp. or health care disparit\*.mp. or health status disparit\*.mp. or health disparit\*.mp. or health inequalit\*.mp. or health inequit\*.mp. or medically underserved.mp.
- 11 (association\* between or (positively associated or negatively associated) or differed by or (were high\* amongst or were low\* amongst) or (inverse relationship with or inversely associated with or inversely related to) or reverse association or differentially affects or evidence of a link between or (significantly adj3 likelihood of) or protective factors for or (differ\* adj2 according to) or (inverse adj2 gradient) or (positive adj2 gradient) or (negative adj2 gradient) or (trends were adj3 across) or (related to adj3 variable\*) or (differences were adj3 explained by) or (significant among or no# significant among)).mp.
- 12 exp Health Status Disparities/or exp Healthcare Disparities/or exp Health Services Accessibility/or exp health equity/or (Medically underserved or disparit\* or ((inequal\* or equity or equal\*) adj3 access\*) or "private health insurance" or private insurance or public insurance or government insurance or commercial insurance or insurance status).ti,ab,kw,kf. or ((health\* or health\*care) adj3 (disparit\* or equal\* or unequal or inequalit\* or equit\* or inequit\* or access\* or inaccess\* or gap\* or gradient\* or variation\* or disadvantage\*).ti,ab,kw,kf. or ((racial or ethnic\* or gender\* or sex) and (minorit\* or differ\* or disparit\*).ti,ab,kw,kf. or ((high\* or low\*) adj2 (educat\* or income\*).ti,ab,kw,kf.
- 13 or/1-12
- 14 (serious gam\* or serious play\* or videogame\* or video gam\* or gamif\* or gameplay\* or gamelike\* or gamebased or gaming or game\$1 or gamer\*).ti,ab.
- 15 exp \*game-based learning/or exp \*game/or exp \*video game/
- 16 14 or 15
- 17 (educat\* or learn\* or teach\* or train\*).ti,ab.
- 18 exp \*learning/or exp \*continuing education/or exp \*interdisciplinary education/or exp \*vocational education/or exp \*medical education/or exp \*education/or exp \*interprofessional education/or exp \*postgraduate education/or exp \*graduate education/or exp \*teaching/
- 19 17 or 18
- 20 13 and 16 and 19
- 21 limit 20 to yr = "2010 -Current"
- 22 limit 21 to embase

Web of Science Core Collection.

- 1 TI=(neighbo?rhood\* or "residential environment\*" or inner?city or "housing instability " or "housing insecurity " or "housing strain " or "housing security " or "mortgage problems " or foreclosure or eviction\* or "housing loss " or "home repossession\*" or "home ownership " or (repossess\* near/3 hous\*) or (repossess\* near/3 propert\*) or "mortgage delinquency " or "mortgage arrears " or "mortgage debt\*" or overcrowding or (living near/1 (outside or inside or near\* or adjacent)) or (household near/2 size) or ("marital status " or "marriage status ") or (widow\* or cohabit\* or divorce\* or single parent\* or live\* alone)) or AB=(neighbo?rhood\* or "residential environment\*" or inner?city or "housing instability " or "housing insecurity " or "housing strain " or "housing security " or "mortgage problems " or foreclosure or eviction\* or "housing loss " or "home repossession\*" or "home ownership " or (repossess\* near/3 hous\*) or (repossess\* near/3 propert\*) or "mortgage delinquency " or "mortgage arrears " or "mortgage debt\*" or overcrowding or (living near/1 (outside or inside or near\* or adjacent)) or (household near/2 size) or ("marital status " or "marriage status ") or (widow\* or cohabit\* or divorce\* or single parent\* or live\* alone))
- 2 TI=(minorit\* or "migration background" or racial or racism or ethnology or race or ethnic\* or non?English or "language other than" or latino\* or latina\* or hispanic\* or whites or caucasian\* or non?white or "Torres Strait Islander " or aboriginal or "native american " or inuit or eskimo or "first nation\*" or indigenous or "english as a second language " or "foreign language" or "cultural deprivation" or acculturation or "cultural diversity" or transient\* or migrant\* or emigra\* or immigra\* or "minority group\*" or prejudic\* or "cultural bias" or discriminat\* or refugee\*) or AB=(minorit\* or "migration background" or racial or racism or ethnology or race or ethnic\* or non?English or "language other than" or latino\* or latina\* or hispanic\* or whites or caucasian\* or non?white or "Torres Strait Islander " or aboriginal or "native american " or inuit or eskimo or "first nation\*" or indigenous or "english as a second language " or "foreign language" or "cultural deprivation" or acculturation or "cultural diversity" or transient\* or migrant\* or emigra\* or immigra\* or "minority group\*" or prejudic\* or "cultural bias" or discriminat\* or refugee\*)
- 3 TI=(occupation\* or unemploy\*) or AB=(occupation\* or unemploy\*)
- 4 TI=("sex disparit\*" or "sex difference\*" or "gender identity" or "sex role" or "sex factor\*" or "wom?n\* role\*" or "m?n\* role\*" or "gender\* role\*" or servicewomen or "gender difference\*") or AB=("sex disparit\*" or "sex difference\*" or "gender identity" or "sex role" or "sex factor\*" or "wom?n\* role\*" or "m?n\* role\*" or "gender\* role\*" or servicewomen or "gender difference\*")
- 5 TI=(Schooling or "educational status" or (education\* near/2 level\*) or ((higher or better or worse or less) near/1 educated) or ((higher or better or worse or less) near/1 level\* of education)) or AB=(Schooling or "educational status" or (education\* near/2 level\*) or ((higher or better or worse or less) near/1 educated) or ((higher or better or worse or less) near/1 level\* of education))
- 6 TI=(religi\*) or AB=(religi\*)
- 7 TI=(disparit\* or inequalit\* or inequit\* or equity or deprivation or gini or "concentration index" or "Social class\*" or "social determinant\*" or "social status" or "social position" or "social background" or "social circumstance\*" or socio-economic or socioeconomic or sociodemographic or socio-demographic or SES or disadvantaged or impoverished or poverty or "economic level" or "assets index" or income\*) or AB=(disparit\* or inequalit\* or inequit\* or equity or deprivation or gini or "concentration index" or "Social class\*" or "social determinant\*" or "social status" or "social position" or "social background" or "social circumstance\*" or socio-economic or socioeconomic or sociodemographic or socio-demographic or SES or disadvantaged or impoverished or poverty or "economic level" or "assets index" or income\*)
- 8 TI=("social exclusion" or (social near/1 (capital or cohes\* or organis\* or organiz\*)) or (community near/3 (cohes\* or participa\*)) or ((neighborhood or neighborhood) near/1 cohes\*) or "social relationship\*" or "social network\*" or "collective efficacy" or "civil society" or "informal social control" or "neighbo?rhood disorder" or "social disorgani?ation" or anomie or "social support" or "social participation" or trust or "emotional support" or "psychosocial support" or "community capital" or "neighbo?rhood cohesion" or "social influence" or (soci\*context\* or soci\*-context\*)) or AB=("social exclusion" or (social near/1 (capital or cohes\* or organis\* or organiz\*)) or (community near/3 (cohes\* or participa\*)) or ((neighborhood or neighborhood) near/1 cohes\*) or "social relationship\*" or "social network\*" or "collective efficacy" or "civil society" or "informal social control" or "neighbo?rhood disorder" or "social disorgani?ation" or anomie or "social support" or "social participation" or trust or "emotional support" or "psychosocial support" or "community capital" or "neighbo?rhood cohesion" or "social influence" or (soci\*context\* or soci\*-context\*))
- 9 TI=("health\*care disparit\*" or "health status disparit\*" or "health disparit\*" or "health inequalit\*" or "health inequit\*" or "medically underserved" or "health services accessibility") or AB=("health\*care disparit\*" or "health status disparit\*" or "health disparit\*" or "health inequalit\*" or "health inequit\*" or "medically underserved" or "health services accessibility")
- 10 TI=("Medically underserved" or disparit\* or ((inequal\* or equity or equal\*) near/3 access\*) or "private health insurance" or "private insurance" or "public insurance" or "government insurance" or "commercial insurance" or "insurance status" or ((health\* or health\*care) near/3 (disparit\* or equal\* or unequal or inequalit\* or equit\* or inequit\* or access\* or inaccess\* or gap\* or gradient\* or variation\* or disadvantage\*)) or ((racial or ethnic\* or gender\* or sex) and (minorit\* or differ\* or disparit\*)) or ((high\* or low\*) near/2 (educat\* or income\*)) or AB=("Medically underserved" or disparit\* or ((inequal\* or equity or equal\*) near/3 access\*) or "private health insurance" or "private insurance" or "public insurance" or "government insurance" or "commercial insurance" or "insurance status" or ((health\* or health\*care) near/3 (disparit\* or equal\* or unequal or inequalit\* or equit\* or inequit\* or access\* or inaccess\* or gap\* or gradient\* or variation\* or disadvantage\*)) or ((racial or ethnic\* or gender\* or sex) and (minorit\* or differ\* or disparit\*)) or ((high\* or low\*) near/2 (educat\* or income\*))
- 11 #10 OR #9 OR #8 OR #7 OR #6 OR #5 OR #4 OR #3 OR #2 OR #1
- 12 TI=((educat\* or train\* or teach\* or learn\*) near/3 ("serious gam\*" or "serious play\*" or videogame\* or "video gam\*" or gamif\* or gameplay\* or gamelike\* or gamebased or gaming or game\* or gamer\*)) or AB=((educat\* or train\* or teach\* or learn\*) near/3 ("serious gam\*" or "serious play\*" or videogame\* or "video gam\*" or gamif\* or gameplay\* or gamelike\* or gamebased or gaming or game\* or gamer\*))
- 13 #11 AND #12
- 14 #11 AND #12
- 15 #11 AND #12 and 2023 or 2022 or 2021 or 2020 or 2019 or 2018 or 2017 or 2016 or 2015 or 2014 or 2013 or 2012 or 2011 or 2010 (Publication Years)

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