



A Systematic Review of the Outcomes, Level, Facilitators, and Barriers to Deep Self-Reflection in Public Health Higher Education: Meta-Analysis and Meta-Synthesis

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Based on 34 studies and to the best of our knowledge, this is the first systematic review consisting of a meta-analysis and a meta-synthesis to illustrate the various self-reflection formats used in public health higher education. Through this review, we aimed to (1) describe the range of self-reflection formats used in public health undergraduate education, (2) compare the level of reflectivity and outcomes of self-reflection according to the common formats of self-reflection used, and (3) compare the facilitators and barriers to deep self-reflection based on the common formats of self-reflection used. Most students were not engaging in reflection at a deep level according to the Mezirow's model of reflexivity. Both meta-analysis and meta-synthesis results revealed self-reflection enhanced self-confidence, professional identity, and professional development as well as improved understanding of public health related topics in these students. Future educational programmes should consider the common facilitators to deep self-reflection, i.e., advocacy on the importance of reflection by instructors and provision of guidance to students and the common barriers, i.e., perception by instructors/students to be time consuming and the imbalance in power relationship between instructors and students. Because perceptions of learning environments varied between institutions, programs, teachers and students, efforts to evaluate the implementation feasibility of these facilitators and barriers need to take place across the different levels. As a start, peer ambassadors or champions could be appointed at the student level to change the common perception that performing deep self-reflection was time consuming. Similarly, at the teacher level, faculty learning communities could be set up for like-minded educators to advocate on the importance of reflection and to share their experience on balancing the power relationship between instructors and students.

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INTRODUCTION

Self-Reflection in Higher Education

Higher education allows an individual to acquire knowledge and skills in a chosen field. It offers an opportunity for prospective graduates to gain insights into the potential challenges and problems they may face in their future careers. However, one concern of higher education is whether students are adequately being prepared for the workforce (Jackson et al., 2016). This arises because graduates may face intricate situations during their career which require critical thinking. The academic knowledge gained from higher education may not always be readily transferable to the workforce. To bridge this gap, higher education institutions have a crucial role to play by better preparing students for the workforce. One pedagogical approach to achieve this is self-reflection, of which one definition is “A conscious mental process relying on thinking, reasoning, and examining one’s own thoughts, feelings, and ideas.” (Gläser-Zikuda, 2012). There are several definitions of self-reflection in higher education literature. These definitions vary depending on whether the focus is on practice or theory; these include philosophical articulations as in Dewey, formulations in theoretical frameworks according to the constructs developed by Schön, to the use of reflection in the experiential learning cycle by Kolb (Brownhill, 2021). Despite this, the value of self-reflection is well recognized across a wide range of contexts and countries (Brownhill, 2021). For example, reflection is generally regarded as being valuable for professional practice and lifelong learning. Moreover, it has been adopted in higher education training and accreditation standards in several countries in Europe and the United States of America, USA (Van Beveren et al., 2018). Reflection and learning are deeply intertwined with each other. Building upon a constructivist perspective on learning, engaging in self-reflection allows students to construct knowledge (Christie and de Graaff, 2017). It is during the actual process of relating specific situations and evaluations from different perspectives to more abstract conceptualizations that meaning is constructed and learning takes place (Biggs, 2012). When students reflect on experiences by analyzing their attitudes, behaviors, beliefs, and emotions, it may lead to new understandings and meanings (Bubnys and Zydziunaite, 2010), which could enhance their motivation to take responsibility for their actions and decisions. In this way, reflection helps in making learning a process. Other reported benefits of self-reflection include increasing the self-efficacy of students toward deep learning leading to greater satisfaction in learning, improved life-long learning attitude, and increased employability (Young, 2018).

Like other disciplines, self-reflection is increasingly considered a crucial element in public health education (Jayatilleke and Mackie, 2013). Public health has seen a shift from postgraduate to undergraduate education in the early 2000 (Riegelman et al., 2015). This global interest probably first began

in the USA (Kiviniemi and Mackenzie, 2017; Luu et al., 2019) due to efforts of the Institute of Medicine and the Association of School and Programs of Public Health recommending all undergraduate students to have access to public health education (Petersen and Weist, 2014). This move has since led to the refining of public health undergraduate curricula to ensure that graduates are well equipped to enter the workforce. Educators need to cultivate students into future public health practitioners and self-reflection is thus recommended as a useful pedagogical tool for undergraduate public health programs (Jayatilleke and Mackie, 2013). This is particularly crucial for this discipline because public health issues are becoming more complex and hence graduates need to be equipped with this competency to better handle them (Jayatilleke and Mackie, 2013). In addition, reflection in public health has been recommended so that practitioners could audit their own practice thereby promoting effectiveness and efficiency in the health-care system which they are serving (Jayatilleke and Mackie, 2013). Beginning the journey of reflection since undergraduate years would serve to remind practitioners that there is no end point to learning about their everyday practice. Unlike other disciplines, reflection in public health needs to go beyond focusing on themselves alone. This is because public health actions often take place across multi-sectoral teams, involve multi-phased interventions and are driven by policy changes (Jayatilleke and Mackie, 2013). This means that in public health, students and practitioners need to be familiar with reflecting not only as an individual entity, but as part of an interprofessional team and the society too. As public health students in higher education, it is thus important to reflect on both internal (e.g., attitudes, skills, experiences, and team dynamics) and external (e.g., policy, professional, and societal influences) factors beyond their own selves (Jayatilleke and Mackie, 2013).

Gaps in Literature on Self-Reflection in Higher Education

Research on self-reflection has more than quadrupled as it gained traction in the past 20 years (Chan and Lee, 2021). Despite its wide implementation in higher education as well as the sizeable pool of empirical studies, there are a few gaps in literature. First, to the best of our knowledge, there is no systematic review pertaining to self-reflection in public health undergraduate education, despite it being one of the significant changes in higher education in the recent years as highlighted earlier. There is a need to review the use of self-reflection in public health undergraduate curricula which contributes increasingly to the global public health workforce (Kanchanachitra et al., 2011). Public health undergraduate education is typically offered as a minor, a major or even a degree globally, therefore students come from various disciplines (Resnick et al., 2018). These students thus have varying prior exposure to self-reflection. Moreover, most reviews on self-reflection target health professional disciplines (i.e., medical, nursing, and allied health) where students come from relatively homogenous background and receive education on direct patient care (Mann et al., 2009; Fragkos, 2016). These reviews do not

Abbreviations: CI, Confidence Interval; ERIC, Education Resources Information Center; FGDs, Focus Group Discussions; MMAT, Mixed Methods Appraisal Tool; PRISMA, Preferred Reporting Items for Systematic Reviews and Meta-Analyses; PROSPERO, International Prospective Register of Systematic Reviews; USA, United States of America.

relate to public health (Mann et al., 2009; Fragkos, 2016). The use of self-reflection differs between these two disciplines due to varying contexts and focuses. Reflective practice is highly context specific. For example, nursing students might be asked to “reflect” on a clinical experience involving administering intravenous antibiotics to a patient according to a predetermined set of hospital protocol of which they are expected to follow. This would contrast with public health students who might be requested to “reflect” on a community project experience involving delivering maternal and child health services to a subpopulation in a rural town where there is a range of aspects to be considered, for example, healthcare team dynamics, family dynamics, cultural norms, and societal impacts. With public health increasingly being incorporated into the curriculum of health professional disciplines (Jayatilleke and Mackie, 2013), there is a need to examine the use of self-reflection and its effectiveness in public health education.

Second, most reviews on this topic focused on the definitions and application of the models of self-reflection (Fragkos, 2016; Marshall, 2019) rather than the level of self-reflection which students engage in. There are various models and frameworks related to self-reflection. For example, Gibb’s reflective cycle covers six stages of reflection where an individual initiate self-reflection by describing what happened, how they feel, assessing whether the experience was positive or negative, analyzing and making sense of the experience, drawing up a conclusion from the experience, and formulating a future action plan (Miller et al., 2020). While various models of reflection might be used, these are often based on a distinction between several levels or types of reflection, ranging from technical and practical to more critical forms of reflection (Van Beveren et al., 2018). Although there is no single “right way” to reflect, and that the value of reflection can be relative to the context in which it is taught, each of these models characterize critical reflection as an important and even necessary form of reflection (Van Beveren et al., 2018). In view of this, it is probably more important to evaluate the levels and dimensions of reflection that students could attain instead of the type of self-reflection model used. For example, Mezirow suggested that reflectivity could be categorized into seven levels and dimensions where the first four stages (reflectivity, affective reflectivity, discriminant reflectivity, and judgmental reflectivity) belonged to the consciousness level while the final three stages (conceptual reflectivity, psychic reflectivity, and theoretical reflectivity) belonged to the critical consciousness level (Mezirow et al., 2012). According to Mezirow, reflectivity (lowest level) involved a basic recollection or the start of being aware of a situation that had transpired without any further follow up. Affective reflectivity referred to reflection stopping at the emotion level, like how an individual was feeling toward a particular experience. Discriminant reflectivity involved an individual reflecting on his or her perceptions, actions, thoughts, and habits of carrying out things in a given situation. Judgmental reflectivity involved being aware of one’s value judgment on one’s experience. For the critical consciousness level, conceptual reflectivity involved questioning oneself if the current information provided was adequate to make a sound judgment. Psychic reflectivity level on the other hand

referred to an individual being aware of his or her preconceived judgment on an experience based on given information. Lastly for theoretical reflectivity, this referred to an individual being aware that his or her preconceived judgment was based on various inadequacies following a perspective transformation (Mezirow et al., 2012). Higher levels of self-reflection foster deep learning (Young, 2018). Low reflection level implies superficial learning, presumably because learners with a limited ability to reflect let “tunnel vision” stop them from questioning their behavior in response to significant positive and negative experiences (Koole et al., 2011). There is thus a need to review the levels and dimensions of reflection students engage in public health curricula to better determine its effectiveness in achieving deep learning.

Third, there has been a recent increase in the incorporation of self-reflection into public health curriculum and programs through various reflective formats like journal, focus group discussion, photovoice, and narrative reflective practice (Sendall and Domocol, 2013; Hoffman and Silverberg, 2015; Babenko-Mould et al., 2016; Adams, 2019; Janssen Breen et al., 2019; Andina-Díaz, 2020; Haffejee, 2021). While Artioli et al. (2021) conducted qualitative meta-synthesis on the use of reflective writing on health professionals, focusing on one type of reflection format is insufficient to determine the impacts of self-reflection in public health higher education. There is a need for a review to identify the broad range of self-reflection formats available in public health education, and not to limit to only one format. Moreover, it is important to elicit the facilitators and barriers to promote deep reflection in higher education. While, Chan and Lee (2021) provided an overview of the challenges of encouraging reflection in higher education, these are not specific to deep reflection which is the desired level students should aspire to attain as highlighted earlier. In addition, facilitators are not reported in the review which could offer valuable insights for future curriculum and program improvement. Facilitators and barriers might also not be similar across the board range of reflective formats. Therefore, there is a need to examine the outcomes, facilitators, and barriers according to the broad range of self-reflection formats available in public health education. The three aims of the current systematic review are to (1) describe the range of self-reflection formats used in public health undergraduate education, (2) compare the level of reflectivity and outcomes of self-reflection according to the common formats of self-reflection used, and (3) compare the facilitators and barriers to deep self-reflection based on the common formats of self-reflection used.

MATERIALS AND METHODS

Guideline for Reporting

This systematic review was conducted in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) Statement (Page et al., 2021). The review protocol was prospectively registered with the International Prospective Register of Systematic Reviews, PROSPERO (Registration ID CRD42021255714).

Literature Search

A combination of computerized and manual searches was performed to identify all relevant data for the systematic review. We searched the following six electronic databases using the date ranges January 1, 2000, to April 30, 2021: Education Resources Information Center (ERIC), ProQuest Central, PubMed, Scopus, Web of Science, and STM Source. In addition, we also manually searched the reference lists of all studies included in this review to identify additional relevant studies.

The electronic database searches were conducted using abstract and title terms. The following were entered for searches in the six electronic databases: (“self-reflection techniques” OR “reflective study” OR “reflective teaching” OR “reflexivity” OR “reflective learning” OR “introspection” OR “reflections” OR “reflective practice”) AND (“public health undergraduates” OR “public health education” OR “public health students” OR “public health pedagogy” OR “public health curriculum” OR “public health training”). No language or publication status restrictions were specified.

Inclusion and Exclusion Criteria

To be included in the review, a study had to meet the following criteria: (1) the students receiving public health education had to be undergraduates. There was no restriction on the major of these students hence students could come from any discipline. However, as a minimum, these students had to be taking a module or curriculum unit on public health; (2) used self-reflection as a pedagogical tool in public health undergraduate education. There was no restriction on the format of self-reflection used; and (3) evaluated the impact of self-reflection on students. The evaluation could be conducted using quantitative, qualitative, or mixed methods. Studies were excluded if: (1) it was not possible to isolate the evaluation results to undergraduates alone in the event where the same type of self-learning was delivered to both undergraduates and postgraduates; and (2) there was only description of self-reflection without any evaluation results.

The first two authors screened the databases and reference lists independently. Citations were merged and duplicates removed. Titles and abstracts were screened using the pre-specified inclusion and exclusion criteria. If at least one of the authors evaluated the title or abstract to be relevant, the full text would be screened. There was a good interrater reliability of Cohen’s kappa coefficient of 0.86. Data extraction focused on study design, setting, type of student, sampling/assignment technique and sample size, format of self-reflection used, outcome measurements, and evaluation results. Any discrepancies in eligibility assessment or data extraction were resolved through discussion to reach a consensus between both authors.

Quality Assessment of Included Studies

Methodological quality of the included studies was independently evaluated by the first two authors using the Mixed Methods Appraisal Tool, MMAT (Hong et al., 2018). This was because the review contained qualitative and mixed methods studies. After responding to two screening questions, each included study was rated in the appropriate category of criteria

as either “yes,” “no” or “can’t tell”. There was a good interrater reliability of Cohen’s kappa coefficient of 0.88. Any discrepancies were resolved through discussion to reach a consensus between both authors. We did not obtain an overall score for each study since this was discouraged in the latest version of the MMAT.

Meta-Analysis Procedure

Most of the outcomes pertaining to the evaluation of self-reflection from the mixed-methods studies in this review were too heterogeneous to be combined. However, there were three to four studies that reported similar outcomes on understanding of public health related topics, career prospect (self-confidence, professional identity, and professional development), communication, and academic skill. Therefore, they were pooled for meta-analysis. Three studies were pooled for the outcome on understanding of public health related topics, three for career prospect, three for communication skill, and four for academic skill. The four outcomes were measured using a five-point Likert scale self-reported by students post-learning. The Inverse Variance method was used to pool the overall mean values of these outcomes across studies (Fleiss, 1993). For studies which published the mean values of outcome with more granular detail than required (e.g., communication skill with stratification by various aspects of communication from Hoffman and Silverberg, 2015), the overall mean value was derived using the average of the given mean values. For studies which published the median values (e.g., communication skill from Sambell et al., 2020), the overall mean value was derived using the given sample size, overall median, and range (Hozo et al., 2005). As all the studies did not publish the standard deviation (SD) of outcomes, this was imputed using sample size, interquartile range, and range, where available (Walter and Yao, 2007; Wan et al., 2014). The SDs were converted to standard errors to estimate the 95% confidence interval (CI) of pooled effect. Heterogeneity between the studies and sampling variance within the studies were assessed using the estimate of the absolute total observed variance T^2 and proportion of the total observed variance from heterogeneity I^2 (Higgins et al., 2003; Cheung, 2019). The low T^2 and moderate to high I^2 of the four outcomes indicated that the total observed variance was low and there was more heterogeneity than sampling error from the studies. Therefore, the random effects model with the method of moments was used for the four outcomes. The Egger test and funnel plot were used to detect publication bias. The meta-analysis was conducted using STATA SE 16 and the results were presented using forest plots.

Meta-Synthesis Procedure

In addition, we conducted a meta-synthesis on the levels and dimensions of reflectivity using the Mezirow’s model of reflexivity, evaluation outcomes of self-reflection as well as the facilitators and barriers to deep self-reflection. Deep self-reflection was defined *a priori* as achieving any of the final three stages (conceptual reflectivity, psychic reflectivity, and theoretical reflectivity) of the critical consciousness level of the Mezirow’s model of reflexivity (Mezirow et al., 2012). A thematic synthesis approach was used to gather information

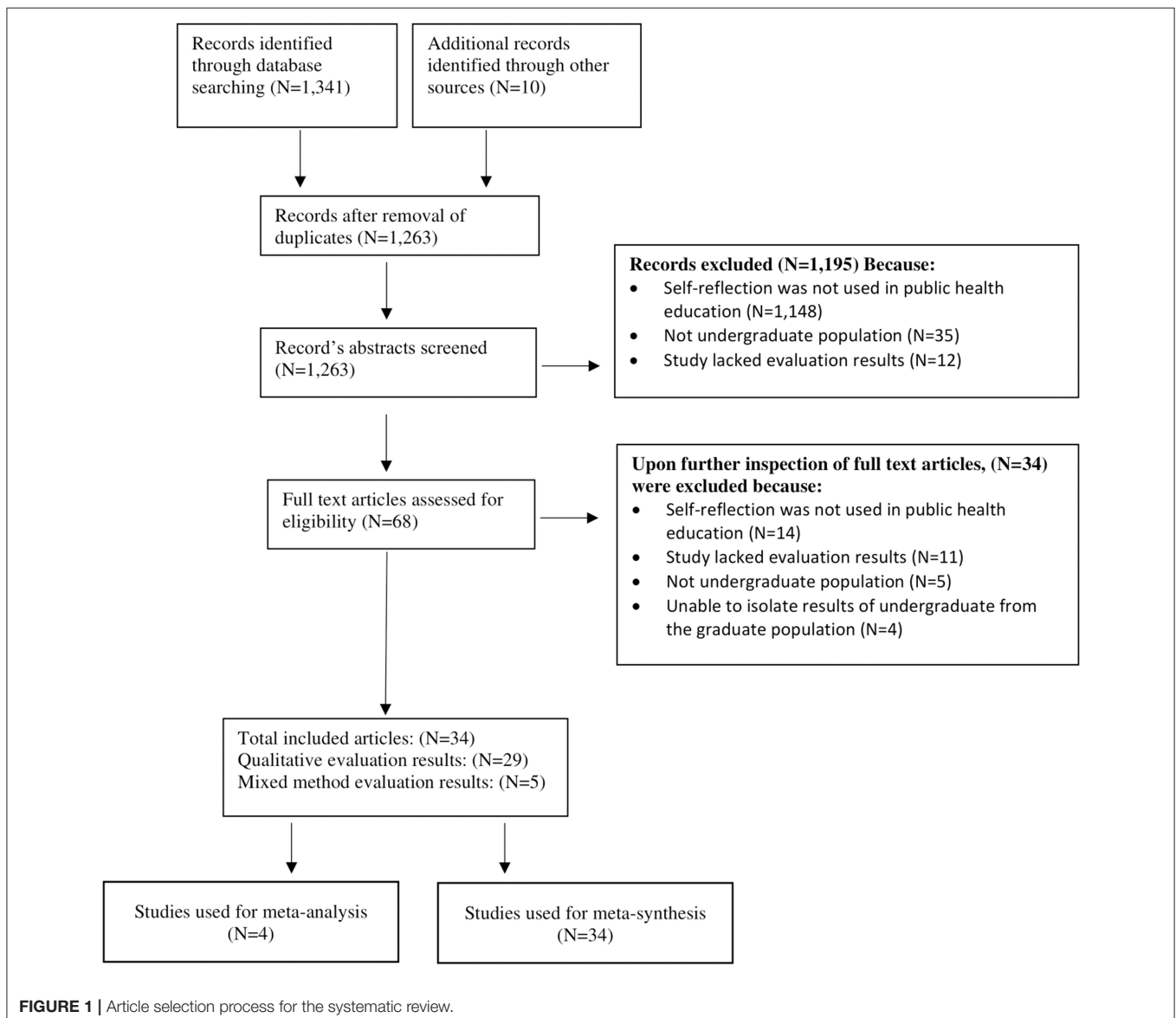
and identify all themes. We adapted the inductive analysis by Sandelowski and Barroso (Ludvigsen et al., 2016) which involved three stages: (1) extraction of findings and coding of findings for each article; (2) grouping of findings (codes) according to their topical similarity to determine whether findings confirm, extend, or refute each other; and (3) abstraction of findings (analyzing the grouped findings to identify additional patterns, overlaps, comparisons, and redundancies to form a set of concise statements that capture the content of findings). All stages were performed simultaneously as recommended (Ludvigsen et al., 2016). All data under Sections “Results,” “Discussion,” and “Conclusions” were read several times, and line by line. Relevant quotes were extracted, and these were analyzed and organized into codes and groupings. We used the process of constant comparative analysis. Emerging groupings from early codings were checked with ongoing coding and used to guide

later coding (Ludvigsen et al., 2016). Final groupings were reviewed to ensure codings were similar in all groups and that no potential groupings were missed during the process (Ludvigsen et al., 2016). Prior to coding, the first two authors discussed, agreed upon, and demonstrated competency on the coding structure. After independently coding, both authors met to discuss coding inconsistencies. Cohen’s kappa coefficient yielded a good agreement of 0.85. Any disagreement was resolved by consensus between both authors.

RESULTS

Descriptive Findings

Our database and manual searches identified 1,351 citations (Figure 1). After removing 88 duplicates, 1,263 citations were reviewed using their titles and abstracts. Of these, 1,195 citations



were excluded for not meeting the inclusion criteria. After reading the remaining 68 articles, 14 were not relevant to self-reflection, 11 did not include evaluation results, five did not meet the target population criteria, and we were unable to isolate the results of undergraduate from the graduate population in four studies. The remaining 34 studies were included in our systematic review (Schaffer et al., 2005; Champagne, 2006; Brondani, 2010; Carroll and McCarthy, 2010; Shepherd, 2010; Lee et al., 2011; Solomon and Risdon, 2011; Leipert and Anderson, 2012; Fortugno et al., 2013; Sendall and Domocol, 2013; Koh et al., 2014; Lencucha, 2014; Oakes and Sheehan, 2014; Stefaniak and Lucia, 2014; Hoffman and Silverberg, 2015; Karlsen et al., 2015; Krumwiede et al., 2015; McKay and Dunn, 2015; Babenko-Mould et al., 2016; Olson and Burns, 2016; Dundas et al., 2017; Padykula, 2017; Rooks and Holliman, 2018; Adams, 2019; Burnett and Akerson, 2019; Harver et al., 2019; Janssen Breen et al., 2019; Njoku and Ferris State University, 2019; Andina-Díaz, 2020; Chang and Chen, 2020; Harrison et al., 2020; Sambell et al., 2020; Suwanbamrung and Kaewsawat, 2020; Haffejee, 2021). Of the 34 studies, 29 reported qualitative evaluation results, and five reported mixed methods evaluation results. Four studies were used for meta-analysis (Hoffman and Silverberg, 2015; Rooks and Holliman, 2018; Njoku and Ferris State University, 2019; Sambell et al., 2020), and 34 were used for meta-synthesis.

Twenty-nine out of 34 studies (85.3%) were qualitative where qualitative descriptive design was the commonest (Table 1). The remaining five (14.7%) were mixed methods where all were of convergent design. On the type of students, more than two-fifths of the studies focused on healthcare professional students such as medical, dental, nursing, or allied health students taking public health as part of their curriculum. Nursing students was the commonest among these students. Another third of the studies targeted students in a major or a degree program in public health. The remaining one-quarter dealt with students from various disciplines such as nutrition, food technology, early childhood education, and child and youth care. There was a wide range of self-reflection formats used. Other than two studies which utilized a self-assessment tool for reflection, majority of the formats could be classified into four broad categories: (i) oral discussion, (ii) written assignment, (iii) photovoice, and (iv) portfolio. Common oral discussion formats included focus group discussions (FGDs), debrief and small group sharing, of which FGDs was the most popular. For written assignment, reflection paper was more popular than reflective journal. Studies that employed photovoice generally required students to take photographs in the community based on a public health topic so that they could reflect upon and explore the reasons, emotions and experiences that have guided their chosen images. For portfolio, the included studies generally required students to self-reflect on their service-learning project or degree program and then to collect evidence of their sample work, demonstrations, and artifacts that showcased their learning progression, competencies acquisition, and achievement. Out of the 34 studies, 24 used the format from only one category. The most common category utilized was the written assignment, followed by oral discussion, photovoice, and then portfolio.

The quality appraisal of the included studies is presented in **Appendix 1**. Thirty-one of the 34 studies fulfilled at least three out of five criteria outlined by the MMAT for each study design.

Meta-Analysis Findings

The meta-analysis of the common outcomes post-learning using the five-point Likert scale is shown in **Figure 2**. The higher the points reported the more favorable was the outcome. All four outcomes had a pooled mean of >3.0 indicating that students generally perceived an improvement for these outcomes post-learning. The pooled mean was the highest for having improved understanding of public health related topics at 4.15 (95%CI 3.65–4.66), followed by improved communication skill at 3.96 (95%CI 3.46–4.46), improved academic skill at 3.89 (95%CI 3.45–4.32), and then enhanced self-confidence, professional identity, and professional development at 3.36 (95%CI 2.80–3.92). In other words, students reported the most favorable outcome of self-reflection in increasing their understanding of public health related topics, followed by an improvement in their communication skill, then an improvement in their academic skill and finally an enhancement in their professional development at the end of learning.

Meta-Synthesis Findings—Levels and Dimensions of Reflection

The evaluation of the levels and dimensions of reflection using the Mezirow's model is shown in **Table 2**. **Appendix 2** shows the illustrative quotes for the levels and dimensions of reflection. In general, students in most studies exhibited the consciousness category (reflectivity, affective reflectivity, discriminant reflectivity, and judgmental reflectivity) rather than the critical consciousness category (conceptual reflectivity, psychic reflectivity, and theoretical reflectivity). Within the consciousness category, students in almost all the studies displayed reflectivity (most superficial level). One example from Shepherd 2010 is "*The emphasis that the alcoholic anonymous speakers made about the initial consumption being a choice made me reflect the most*". Other than reflectivity, these students also displayed discriminant reflectivity. One example from Sambell et al. (2020) is "*The down point of the session was the introduction didn't provide a clear pathway for what the session was to entail and a couple of questions that didn't inspire responses from the participants. The challenging thing about the session was being mindful and ensuring no one was offended or uncomfortable*". Other levels in this category included affective reflectivity like Janssen Breen et al. (2019), "*[I was] surprised that initially going in, thinking it was an area in need and that the parents were not going to be so involved—but they were*" as well as judgmental reflectivity such as Lee et al. (2011), "*I think the most important contribution that this process to my functioning as a health promoter is to look at issues on a more social rather than individualistic scale... I think that if a focus on health education and promotion was on strengthening communities, many societal problems would be decreased... If people felt fulfilled through friends and family perhaps, they would not feel the need to succumb to advertisements suggesting over-consumption*".

TABLE 1 | Characteristics of included studies.

References	Study type	Study design	Educational institute and country	Type of student	Sample size and sampling/assignment technique	Module/course/programme	Format(s) of self-reflection
Adams, 2019	Qualitative	Qualitative descriptive	Indiana University Northwest, United States of America	Nursing students	101 students (52 in 2016 and 49 in 2017) All students were invited to participate	Introductory-level population health course	Oral discussion in the form of debrief Written assignment in the form of reflection paper
Andina-Díaz, 2020	Qualitative	Qualitative descriptive	University of León, Spain	Nursing students	91 students Convenience sampling	Community health nursing module	Photovoice
Babenko-Mould et al., 2016	Qualitative	Qualitative descriptive	Western University, Canada	Nursing students	34 students 19 out of the 34 students also participated in the focus group discussions (FGDs) Purposive sampling	Community health nursing course	Oral discussion in the form of FGDs Written assignment in the form of reflection paper
Janssen Breen et al., 2019	Qualitative	Qualitative descriptive	Farmingdale State College, Molloy College, and St. Joseph's College, United States of America	Nursing students	42 students Purposive sampling	Community/public health nursing program	Oral discussion in the form of FGDs
Brondani, 2010	Qualitative	Qualitative descriptive	University of British Columbia, Canada	Dental students	121 students (40 from 2007-08, 42 from 2008-09 and 39 from 2008-09) Sampling method not specified	Community health service-learning module/project	Written assignment in the form of reflection paper and reflective journal
Burnett and Akerson, 2019	Qualitative	Case study	James Madison University, United States of America	Public health students	106 students All students were invited to participate	Public health ethics and critical thinking course	Written assignment in the form of reflection paper
Carroll and Mccarthy, 2010	Qualitative	Qualitative descriptive	Queensland University of Technology, Australia	Public health students	40 students All students were invited to participate	Women's health module	Written assignment in the form of reflection paper
Champagne, 2006	Mixed method	Convergent design Quantitative component: One-group, post-test only design Qualitative: Qualitative descriptive	University of Massachusettes, United States of America	Public health students	12 students Sampling method not specified	Community health service-learning project	Quantitative component: Annotated portfolios that were scored using a rubric Qualitative component: Written assignment in the form of reflection paper
Chang and Chen, 2020	Qualitative	Qualitative descriptive	Chang Gung University of Science and Technology, Taiwan	Nursing students	57 students Sampling method not specified	Health Promotion Course	Written assignment in the form of reflective journal
Dundas et al., 2017	Qualitative	Case study	University of Newcastle, Australia	Allied health students	139 students Convenience sampling	Introductory public health module	Photovoice
Fortugno et al., 2013	Qualitative	Case study	Ryerson University, Canada	Students from nutrition, nursing, early childhood education, and child and youth care	4 students Convenience sampling	Interprofessional education to develop and deliver modules on healthy living to secondary school students	Oral discussion in the form of FGD Written assignment in the form of reflection form
Haffeejee, 2021	Qualitative	Qualitative descriptive	Durban University of Technology, South Africa	Allied health students	56 students Purposive sampling	Epidemiology: Public Health module	Photovoice

(Continued)

TABLE 1 | Continued

References	Study type	Study design	Educational institute and country	Type of student	Sample size and sampling/assignment technique	Module/course/ programme	Format(s) of self-reflection
Harrison et al., 2020	Qualitative	Phenomenology	Cape Peninsula University of Technology, South Africa	Emergency care students	80 students Sampling method not specified	Community-based service-learning projects	Written assignment in the form of reflection paper
Harver et al., 2019	Mixed Methods	Convergent design Quantitative component: One-group post-test only design Qualitative component: Qualitative descriptive	University of North Carolina at Charlotte, United States of America	Public health students	94 students from 3 cohorts (2016-17, 2017-18, 2018-19) All students were invited to participate	Bachelor of Science in Public Health (BPSH) capstone course	Quantitative component: ePortfolios rated using the Valid Assessment of Learning in Undergraduate Education (VALUE) Rubrics and other resources Qualitative component: Reflective narration of ePortfolio
Hoffman and Silverberg, 2015	Qualitative	Case study	McMaster University, Canada	Health Sciences and Arts and Science program students	19 students Sampling method not specified	Experiential education course in global health advocacy	Written assignment in the form of reflection paper
Karlsen et al., 2015	Qualitative	Case study	Sør-Trøndelag University College, Norway	Food technology program students	9 students for the reflection paper 5 students for the FGD Sampling method not specified	Epidemiologic play (epi-play) on food-borne outbreaks	Written assignment in the form of reflection paper Oral discussion in the form of FGD
Koh et al., 2014	Qualitative	Qualitative descriptive	National University of Singapore, Singapore	Medical students	41 students Sampling method not specified	Public health communication course	Written assignment in the form of reflective journal
Krumwiede et al., 2015	Qualitative	Case study	Minnesota State University, United States of America	Nursing students	15 students Sampling method not specified	Community health based service learning project	Written assignment in the form of reflective journal
Lee et al., 2011	Qualitative	Qualitative descriptive	University of Lethbridge, Canada	Public health students	21 students 4 students for FGD Sampling method not specified	Health promotion course	Oral discussion in the form of FGD Written assignment in the form of reflection paper
Leipert and Anderson, 2012	Qualitative	Qualitative descriptive	Western University, Canada	Nursing and health sciences students	36 students Sampling method not specified	Rural health nursing course	Photovoice
Lencucha, 2014	Qualitative	Qualitative descriptive	University of Lethbridge, Canada	Public health students	20 students Sampling method not specified	Introductory global health course	Written assignment in the form of reflection paper
McKay and Dunn, 2015	Qualitative	Qualitative descriptive	Deakin University, Australia	Public health students	15 students 7 from 2012 cohort, 8 from 2013 cohort Sampling method not specified	Introduction to Public Health and Health Promotion	Written assignment in the form of reflective journal
Njoku and Ferris State University, 2019	Qualitative	Qualitative descriptive	Ferris State University, United States of America	Public health, nursing, and other major students	52 students Sampling method not specified	Rural Public Health Programme	Written assignment in the form of reflection paper
Oakes and Sheehan, 2014	Qualitative	Qualitative descriptive	University of Hartford, and University of Connecticut, United States of America	Health Sciences students	23 students Sampling method not specified	Community-based service-learning project related to aging	Written assignment in the form of reflection paper

(Continued)

TABLE 1 | Continued

References	Study type	Study design	Educational institute and country	Type of student	Sample size and sampling/assignment technique	Module/course/ programme	Format(s) of self-reflection
Olson and Burns, 2016	Mixed Methods	Convergent design Quantitative component: one-group post-test- only design Qualitative component: Qualitative descriptive	Western Sydney University, Australia	Public health students	28 students were invited but only 16 completed the reflective learning tool, i.e., consumption worksheet Sampling method not specified	Public health course on consumption behaviors	Quantitative component: Reflective learning tool, i.e., consumption worksheet rated using a 5-point Likert scale Qualitative component: Oral discussion in the form of small group sharing
Padykula, 2017	Qualitative	Case study	Western Connecticut State University, United States of America	Nursing students	15 students Purposive sampling	Course on self-care and health promotion	Written assignment in the form of reflective journal
Rooks and Holliman, 2018	Qualitative	Qualitative descriptive	University of Colorado Denver, United States of America	Public health students	53 students Sampling method not specified	Health Policy Course	Written assignment in the form of reflection paper
Sambell et al., 2020	Mixed Methods	Convergent design Quantitative component: one- group post-test-only design Qualitative component: Qualitative descriptive	Edith Cowan University, and University of Canberra, Australia	Nutrition major students	19 students Sampling method not specified	Community Nutrition Course	Quantitative component: Scoring of the Employability Skills Cluster Matrix-Self Assessment Tool (ESCM-SAT) Qualitative component: Written assignment in the form of reflection paper
Schaffer et al., 2005	Mixed Methods	Convergent design Quantitative component: one-group post-test only design Qualitative component: Qualitative descriptive	Bethel University, United States of America	Nursing students	53 students Random sampling	Community health nursing course	Quantitative component: Scoring of portfolio using a 4-point Likert scale Qualitative component: Reflective narration of portfolio and FGDs
Sendall and Domocol, 2013	Qualitative	Phenomenology	Queensland University of Technology, Australia	Public health students	32 students Sampling method not specified	Public Health Practice course	Written assignment in the form of reflective journal
Shepherd, 2010	Qualitative	Case study	University of Auckland, New Zealand	Health Sciences students	14 students Sampling method not specified	Community and Addiction Course	Written assignment in the form of reflection paper

(Continued)

TABLE 1 | Continued

References	Study type	Study design	Educational institute and country	Type of student	Sample size and sampling/assignment technique	Module/course/ programme	Format(s) of self-reflection
Solomon and Risdon, 2011	Qualitative	Qualitative descriptive	McMaster University, Canada	Medical students	164 students 5 students for the FGD All students were invited to participate	Professional competencies course with 2 community-based visits	Written assignment in the form of reflection paper
Stefaniak and Lucia, 2014	Qualitative	Qualitative descriptive	Oakland University, United States of America	Medical students	48 students Sampling method not specified	Promotion and Maintenance of Health Course	Oral discussion in the form of FGD Written assignment in the form of reflection paper
Suwanbarmung and Kaewsawat, 2020	Qualitative	Phenomenology	Walailak University, Thailand	Public health students	90 students Sampling method not specified	Community Public Health Programme	Written assignment in the form of reflection paper

Within the critical consciousness category, the most common levels were conceptual and theoretical reflectivity. Students from Fortugno et al. (2013) exhibited conceptual reflectivity such as, “It almost makes me [wonder], do I want to work in a room full of [people of the same profession] now? Because we do come from the same basic perspective... Or would I almost prefer to work with a team of people who are [from different] professions, who give me all of those resources... and we get to collaborate?”. Students from seventeen studies displayed theoretical reflectivity where an example from Adams (2019) is, “We expect people to be able to make good health decisions. But if they don’t have money or resources, it isn’t that simple. I realize this now after this class.” The level least exhibited was psychic reflectivity involving only four studies. An example is Leipert and Anderson (2012), “The close-knit culture found within rural communities can often make it difficult for new residents to be accepted, as they may be viewed as strangers or outsiders”.

Meta-Synthesis Findings—Outcomes of Self-Reflection Across the Reflection Formats

Table 3 shows the themes and subthemes on the outcomes of self-reflection across the reflection formats. Appendix 3 shows the illustrative quotes for the themes and subthemes on the outcomes of self-reflection. There were more positive than negative outcomes for each of the four formats of reflection (oral discussion, written assignment, photovoice, and portfolio) except for portfolio where positive outcomes were only reported. For all the formats of reflection, the top two positive outcomes were enhanced self-confidence, professional identity, and professional development and improved understanding on public health related topics. For the former, examples of quotes included, “I don’t really say as much as I should be, but I think this has really showed me that I should [be more outspoken], especially in a professional aspect of it. I think I brought some valuable things to the table, and [I need to] express that.” (oral discussion, Fortugno et al., 2013), “I enjoyed and benefited from improving my interview skills and enhancing my professional role. I now understand the time and effort required to develop a safe, healthy community, and appreciate the efforts made by public health nurses.” (written assignment, Krumwiede et al., 2015), “I went to public places and people were looking at me whilst I was doing this. I explained to them about the campaign ... I was feeling proud that I could explain to them what the campaign was about due to my knowledge and research on the campaign beforehand. Everyone gave me positive responses. I felt like a professional.” (photovoice, Dundas et al., 2017), and “These experiences improved my cultural competency, cross-cultural communication, ability to navigate ambiguous situations, and creativity regarding health communication materials. My experiences only reconfirmed for me that I want to continue working with diverse and vulnerable populations.” (portfolio, Harver et al., 2019). For the latter, examples of quotes included, “In all honesty, I think I was quite naïve as to what public health actually meant, thinking it was all posters and ad campaigns. Thankfully, this course has broadened my attitude and knowledge relating to public health, to the point

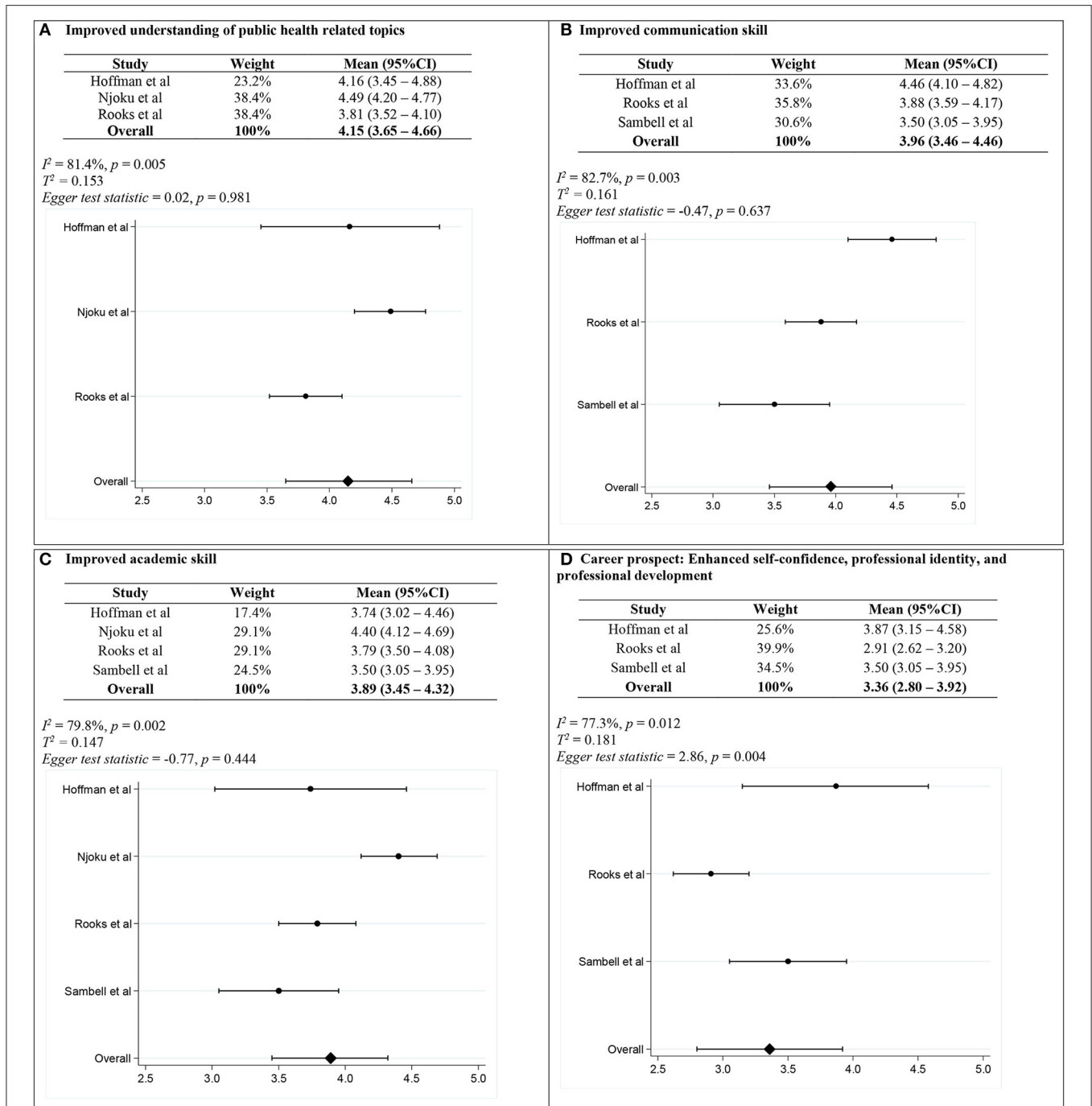


FIGURE 2 | Forest plots illustrating the pooled mean value for (A) understanding of public health related topics, (B) communication skill, (C) academic skill, and (D) career prospect.

where I would now want to focus my attention on preventative health rather than primary.” (written assignment, McKay and Dunn, 2015), and “I began to realise the extent to which public health issues encapsulate most aspects of my lifestyle and those around me. Whether it be my habitual hygiene practices and my knowledge of their purpose, or the unpolluted air I inhale,

assured of its safety, I was swiftly made to acknowledge my own ignorance in taking such aspects for granted.” (photovoice, Dundas et al., 2017).

The next common positive outcomes included improved teamwork skills (oral discussion, written reflection, and photovoice) and improved empathy for the community (oral

TABLE 2 | Evaluation of the levels and dimensions of self-reflection using the Mezirow's model.

References	Consciousness				Critical consciousness		
	Reflectivity	Affective reflectivity	Discriminant reflectivity	Judgemental reflectivity	Conceptual reflectivity	Psychic reflectivity	Theoretical reflectivity
Adams, 2019	✓	✓		✓	✓		✓
Andina-Díaz, 2020	✓		✓	✓			
Babenko-Mould et al., 2016	✓	✓	✓				✓
Janssen Breen et al., 2019	✓	✓	✓	✓	✓		✓
Brondani, 2010	✓	✓	✓	✓	✓		
Burnett and Akerson, 2019	✓	✓	✓	✓			
Carroll and Mccarthy, 2010	✓	✓		✓	✓		✓
Champagne, 2006	✓						
Chang and Chen, 2020	✓	✓	✓	✓			
Dundas et al., 2017	✓	✓	✓	✓	✓		✓
Fortugno et al., 2013	✓	✓	✓		✓		
Haffejee, 2021	✓	✓	✓	✓	✓		
Harrison et al., 2020	✓	✓	✓			✓	✓
Harver et al., 2019			✓		✓		
Hoffman and Silverberg, 2015	✓	✓	✓				
Karlsen et al., 2015	✓		✓				
Koh et al., 2014	✓	✓	✓	✓	✓	✓	
Krumwiede et al., 2015			✓				
Lee et al., 2011	✓	✓	✓	✓	✓		✓
Leipert and Anderson, 2012	✓		✓	✓		✓	
Lencucha, 2014	✓	✓	✓		✓		
McKay and Dunn, 2015	✓	✓	✓	✓			✓
Njoku and Ferris State University, 2019	✓	✓	✓	✓			✓
Oakes and Sheehan, 2014	✓		✓		✓		✓
Olson and Burns, 2016	✓	✓	✓		✓		
Padykula, 2017	✓	✓	✓	✓			✓
Rooks and Holliman, 2018	✓	✓	✓				✓
Sambell et al., 2020	✓	✓	✓				✓
Schaffer et al., 2005	✓	✓	✓	✓	✓		✓
Sendall and Domocol, 2013	✓	✓	✓				
Shepherd, 2010	✓	✓	✓	✓	✓		✓
Solomon and Risdon, 2011			✓	✓	✓	✓	✓
Stefaniak and Lucia, 2014	✓		✓	✓	✓		✓
Suwanbamrung and Kaewsawat, 2020	✓	✓	✓				
Number of studies	31	25	31	19	17	4	17

discussion, written reflection, and portfolio). For the former, examples of quotes included, “*Being part of team teaching was helpful because you could pull from each other’s strengths. Everyone brings a different experience to the team, and we learned a lot from each other. [You] need a team to teach; it is difficult for one person to teach a program.*” (oral discussion, Janssen Breen et al., 2019), and “*We have learnt to function well as a team, but vital to teamwork are communication, co-ordination, balanced member contributions, mutual support, effort and cohesion. Also, we learnt that the group leader needs to delegate.*”

(written reflection, Harrison et al., 2020). For the latter, examples of quotes included, “*I found that the community itself had so much less than mine. The concerns that I have were...how can we help or improve lives here? Who do we go to—to advocate for them?... Being in the hospital we don’t see what happens in the community...there is a huge difference in quality of life just 40 min away. The difference in the way the community presents itself—these children have every right to have what my kids have. How do we make this change for them?*” (oral discussion, Janssen Breen et al., 2019), and “*I learned that the prisoners are just real*

TABLE 3 | Themes and subthemes on the outcomes of self-reflection.

Themes	Subthemes	Andina-Diaz, 2020	Janssen Breen et al., 2019	Brondani, 2010	Burnett and Akerson, 2019	Carroll and McCarthy, 2010	Chang and Chen, 2020	Dundas et al., 2017	Fortugno et al., 2013	Hafejee, 2021	Harrison et al., 2020	Harver et al., 2019	Hoffman and Silverberg, 2015	Koh et al., 2014	Krumwiede et al., 2015	Lee et al., 2011	Lencucha, 2014	McKay and Dunn, 2015	Njoku and Ferris State University, 2019	Oakes and Sheehan, 2014	Olson and Burns, 2016	Padykula, 2017	Rooks and Holliman, 2018	Sambell et al., 2020	Schaffer et al., 2005	Sendall and Domocol, 2013	Shepherd, 2010	Solemon and Risdon, 2011	Stefaniak and Lucia, 2014	Suwanbammung and Kaewsawat, 2020		
Oral discussion																																
Positive outcomes	Enhanced self-confidence, professional identity, and professional development (4)		✓						✓							✓										✓						
	Improved understanding of public health related topics (2)															✓										✓						
	Improved teamwork skills (2)			✓					✓																							
Negative outcomes	Improved empathy for the community (2)		✓													✓																
	Lack of guidance and support from instructors (1)																									✓						
	Time consuming (1)																									✓						
	Restriction by course/programme requirements (1)																									✓						
	Unpleasant experience with teamwork (1)								✓																							
Written assignment																																
Positive outcomes	Enhanced self-confidence, professional identity, and professional development (14)				✓	✓	✓				✓		✓	✓	✓	✓		✓		✓		✓		✓	✓						✓	
	Improved understanding of public health related topics (14)			✓							✓		✓	✓		✓	✓	✓	✓		✓	✓	✓			✓	✓	✓				
	Improved advocacy skills for public health (4)				✓						✓			✓		✓																
	Improved empathy for the community (4)				✓												✓								✓							
	Improved teamwork skills (3)								✓		✓																					
	Improved communication skills (2)																															
	Enhanced enjoyment of course/program (2)																															
	Improved information technology skills (1)																															
Negative outcomes	Lack of sufficient guidance and support from instructor (8)			✓		✓	✓							✓			✓						✓	✓		✓						
	Unpleasant experience with teamwork (4)								✓				✓	✓									✓									
	Restriction by course/programme requirements (3)																															
	Frustration with social injustice (1)																															
Photovoice																																
Positive outcomes	Enhanced self-confidence, professional identity, and professional development (3)	✓						✓		✓																						

(Continued)

TABLE 3 | Continued

Themes	Subthemes	Andina-Diaz, 2020	Janssen Breen et al., 2019	Brondani, 2010	Burnett and Alkerson, 2019	Carroll and Mccarthy, 2010	Chang and Chen, 2020	Dundas et al., 2017	Fortugno et al., 2013	Haffejee, 2021	Harrison et al., 2020	Harver et al., 2019	Hoffman and Silverberg, 2015	Koh et al., 2014	Krumwiede et al., 2015	Lee et al., 2011	Lencucha, 2014	McKay and Dunn, 2015	Njoku and Ferris State University, 2019	Oakes and Sheehan, 2014	Olson and Burns, 2016	Padykula, 2017	Rooks and Holliman, 2018	Sambell et al., 2020	Schaffer et al., 2005	Sendall and Domocol, 2013	Shepherd, 2010	Solomon and Risdon, 2011	Stefaniak and Lucia, 2014	Suvanbammung and Kaevsawat, 2020			
	Improved understanding of public health related topics (3)	✓						✓		✓																							
	Improved advocacy skills for public health (2)							✓		✓																							
	Improved creativity skills (1)	✓																															
	Improved teamwork skills (1)	✓																															
Negative outcomes	Difficulty in capturing a relevant photo on the topic (1)							✓																									
	Frustration with social injustice (1)							✓																									
Portfolio																																	
Positive outcomes	Enhanced self-confidence, professional identity, and professional development (2)											✓														✓							
	Improved understanding of public health related topics (2)											✓														✓							
	Improved empathy for the community (1)																									✓							

Number inside the bracket indicates the number of studies with the subtheme.

people who have gotten themselves into legal trouble. Before this experience I had always thought of prisoners as constantly being brutally mean and loud-mouthed people. Maybe some are, but it is not a constant personality trait. I felt a lot of sadness and compassion for the prisoners....” (portfolio, Schaffer et al., 2005).

For the negative outcomes, these varied across the different formats of reflection. There were still common outcomes such as lack of sufficient guidance and support from instructor (oral discussion and written assignment), and restriction by course/program requirements (oral discussion and written assignment). For the former, examples of quotes included, “*The preceptors have no clue what we’re doing, what we need.*” (oral discussion, Schaffer et al., 2005) and “*Tutorial briefing was too brief and not ‘structured’ enough*” (written assignment, Koh et al., 2014). For the latter, examples of quotes included, “*I had to alter my writing to fit what they wanted to be more appropriate for the portfolio...I don’t think it had to be so tight...to be reflective writing.*” (oral discussion, Schaffer et al., 2005) and “*I didn’t like the models we had to follow. As a personal reflection I think it should be just that, we should be able to write the way we want. However, it was probably put there for us to use for a good reason.*” (written assignment, Sendall and Domocol, 2013).

Other common outcomes included unpleasant experience with teamwork (oral discussion and written assignment) and frustration with social injustice (written assignment and photovoice). For the former, examples of quotes included, “*When I first came in, I was so terrified that I was going to step on anyone’s toes... I was just scared that I was going to say something wrong, that I might be offensive to another profession.*” (oral discussion, Fortugno et al., 2013) and “*The most challenging part of working in a group was ensuring that all group members were doing an equal amount of work. For example, some people had to include more information in their part and ended up doing more work than others. In addition, it was hard to find days where everybody could meet, and not all team members were able to meet deadlines.*” (written assignment, Rooks and Holliman, 2018). For the latter, examples of quotes included, “*... disappointment that these women have had such an unfair experience in life and disgust that domestic violence is so prevalent within our society*” (written assignment, Sambell et al., 2020) and “*I still cannot understand how these people (Aboriginal Australians) have such poor health outcomes with little improvement in life expectancy when so much available [sic] to improve the social conditions. The more I read the angrier I be (sic).*” (photovoice, Dundas et al., 2017).

Meta-Synthesis Findings—Facilitators and Barriers to Performing Deep Self-Reflection by Students According to the Different Formats

Figure 3 summarizes the facilitators and barriers to performing deep self-reflection by students according to the different formats. While there were distinct facilitators and barriers for each format, there were certain similarities too. For example, there were two common facilitators, i.e., advocacy on the

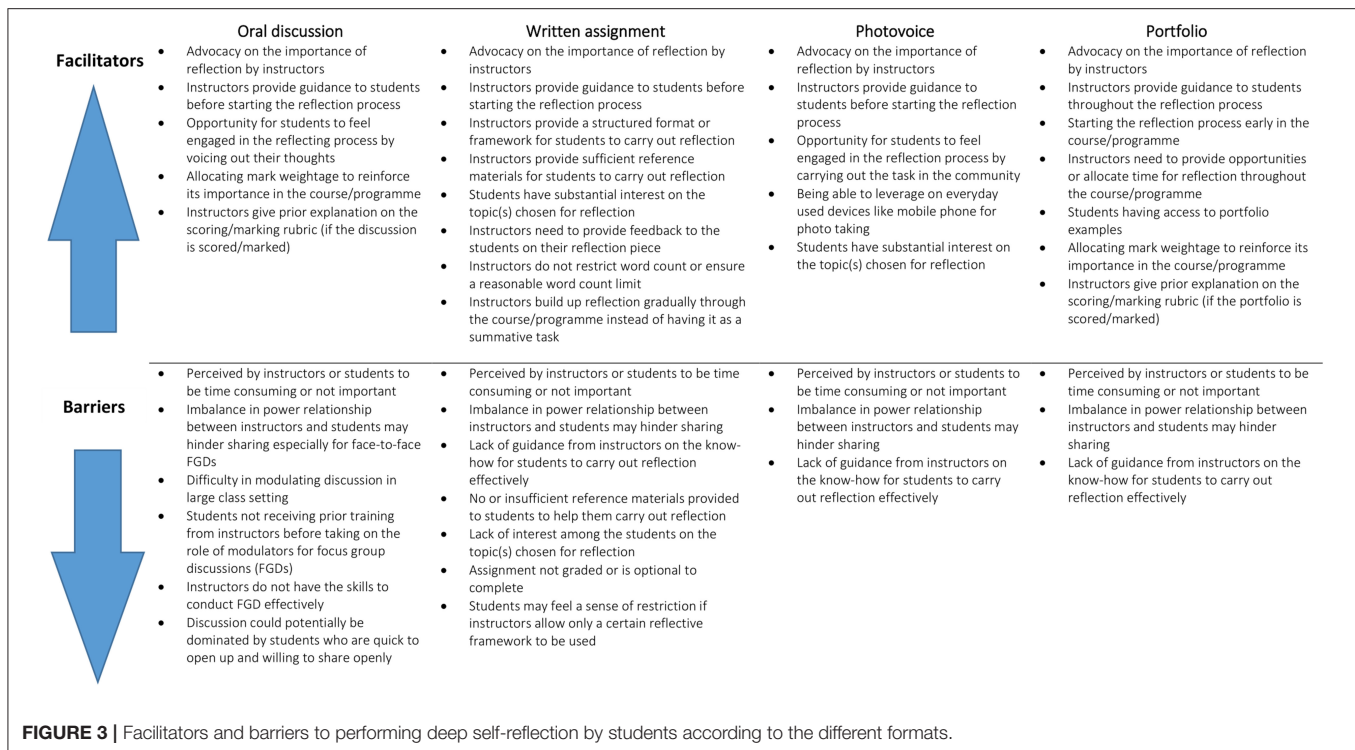
importance of reflection by instructors and instructors provide guidance to students before starting the reflection process. Simultaneously there were also two common barriers, i.e., perception by instructors/students to be time consuming or unimportant as well as the imbalance in power relationship between instructors and students. Another common barrier was the lack of guidance from instructors on the know-how for students to carry out reflection effectively for the formats of written assignment, photovoice and portfolio. Certain barriers were specific only to that format. For example, some barriers specific to oral discussion were difficulty in modulating discussion for large class size, instructors not having the skills to conduct FGDs effectively, and students not receiving prior training from instructors before taking on the role of moderators for FGDs.

DISCUSSION

Findings and Contribution to Literature

This was the first review consisting of a meta-analysis and a meta-synthesis to highlight the different formats of self-reflection used in public health education. Oral discussion and written assignment were more common reflection formats compared to photovoice and portfolio. The review also indicated that students in most studies were reflecting at the superficial rather than the deep level where the quotes pertained mainly to the dimensions of reflectivity and discriminant reflectivity of the Mezirow’s model. While there was an overwhelmingly positive outcomes across the reflection formats, reported negative outcomes especially for portfolio were lacking. Both meta-analysis and meta-synthesis results revealed enhanced self-confidence, professional identity, and professional development as well as improved understanding of public health related topics. Two common facilitators to performing deep self-reflection by students included advocacy on the importance of reflection by instructors as well as instructors providing guidance to students before starting the reflection process. There were also two common barriers, i.e., perception by instructors/students to be time consuming or unimportant as well as the imbalance in power relationship between instructors and students.

Other than the conventional format of written assignment and oral discussion, other forms of self-reflection such as photovoice and portfolio are getting more popular. The nature of portfolio enables a student to not only display, but also to reflect on his or her achievements and competencies. This is relevant in health sciences and public health given the increasing emphasis of a competency-based, and reflective education (Gruppen et al., 2012; Fragkos, 2016). Even after graduation, students could still leverage on the portfolio to continue recording their professional development and hence helps in lifelong learning (Baris and Tosun, 2011). This is particularly so in public health as the graduate would often have to maintain proof of competency for further training and career advancement. The other increasingly popular self-reflection format is photovoice. This was originally created for research purposes to allow participants to capture photos for observation, discussion, and reflection (Kile, 2022).



It has since then been applied in pedagogy including public health higher education (Leipert and Anderson, 2012; Andina-Díaz, 2020; Haffjee, 2021). This is not surprising given that public health has a strong emphasis on the community, and that photovoice creates a visual representation of theoretical concepts and learning experiences that might otherwise be challenging for some students to capture with words (Garner, 2013). Moreover, students might prefer this format compared to other forms because they could use the photographs to critically discuss the deep meanings and the symbolism these represent (Wilson et al., 2017).

Implications for Practice and Directions for Future Research

One key finding was that students in most studies were not engaging in reflection at a deep level. This is consistent with studies from other disciplines (Richardson and Maltby, 1995; Sumsion and Fleet, 1996; Pee et al., 2002). When students first embark on their journey in higher education, they often tend to be superficial and merely descriptive in their reflections (Hatton and Smith, 1995). This is especially evident in junior undergraduate students where they would often prefer to focus on facts, principles, and procedures rather than engage in deep level reflective thinking (Veine et al., 2019). It is thus important to support students and carefully introduce reflection into their learning strategies through clear guidance and activities integrated into the course/program (Veine et al., 2019), as well as to ensure constructive alignment between reflection activities, assessment practices, and learning outcomes (Harvey et al., 2010). This is highly relevant in public health education where

students usually come from diverse disciplines, and that their prior exposure to self-reflection would vary.

Despite the superficial level of reflection, several positives were also demonstrated. Students valued self-reflection in their respective public health course/program from the various positive outcomes in the meta-analysis and meta-synthesis. One such common outcome was improved understanding of public health related topics. Learning can be reinforced through reflective activities for students (e.g., Harvey et al., 2016). The ability to critically reflect is closely related to the higher order cognitive processes of self-regulation and metacognition and thus indicates the extent of the abstract level of learning attained (Paris and Winograd, 2003). Moreover, adopting a learner-centered approach to teaching allows students to take an active and reflective role in their own learning (Weimar, 2013). This approach is highly relevant in the training of public health professionals since there is usually a collective effort involving students, educators, and industry stakeholders.

Another positive common outcome was enhanced self-confidence, professional identity, and professional development. The landscape of higher education is rapidly changing. The role of universities is now not restricted to impart knowledge, but increasingly there is demand and pressure to prepare students for their future careers (Saito and Pham, 2021). Bramming (2007) further added that universities “must be concerned with transformative learning and education, which is then seen as a process where students are active participants, not consumers, users, or clients. Therefore, ample opportunities must be available for students to develop the professional, social, critical, cultural,

and personal aspects of professional identity. This requires students to be actively engaged in their learning along with adequate guidance from educators. It is thus crucial to give reflection a central place in higher education to strengthen students' professional identity (Trede et al., 2012; K rkk  et al., 2016). Reflection connects new experiences with existing knowledge and skills in relation to the student's profession. This can give meaning to their experiences and lead to insights regarding their professional identity (Ayll n et al., 2019). It is thus important that students be provided with authentic experiences to reflect together with educators (Hunter et al., 2007). At the organizational, community and policy level, it will also be important to promote public health higher education programs that foster reflective professional practices (Trede et al., 2012).

Despite the overwhelmingly positive outcomes across the reflection formats, this review has demonstrated a lack of reported negative outcomes especially for portfolio. One reason could be the recent use of this reflection format in public health undergraduate education compared to other more established healthcare undergraduate disciplines like medicine or nursing. Studies from these disciplines reported that there were various negative outcomes in the use of portfolio. These included students viewing the portfolio as time consuming and do not see the importance of it (Abouzeid and Nasser, 2018; Al-Madani, 2019), insufficient feedback provided by the instructor, concerns with academic plagiarism (Al-Madani, 2019), dissatisfaction with the grading system as grading by instructors were inconsistent and guidance were not clear enough, and also students felt disengaged with the portfolio assessment (Vance et al., 2017; Fida et al., 2018; Al-Madani, 2019).

Given the review outcomes, educators, researchers in pedagogy, higher education curriculum or program developers should take note of the facilitators and barriers to performing deep self-reflection in **Figure 3** when developing self-reflection activities for students in the future. One such common facilitator included advocacy on the importance of reflection by instructors and one such barrier included perception by instructors/students to be time consuming or unimportant. Therefore, for reflection to be effective in teaching, both educators and students must be convinced of its importance. Educators are directly responsible for the running of the classes and thus have an important role to play in advocacy. This means that educators need to be more active in the decisions that will shape students' lives (Roberts and Siegle, 2012). If teachers believe in the importance of reflection, they should be advocating for it by encouraging their students to reflect on, analyze, evaluate, and improve their own learning. In contrast, teachers who do not value reflection are not likely to motivate students to engage in reflection (Butani et al., 2017). Promoting reflective practice not only benefits teachers and students, but also the entire educational institution. Developing a culture of reflective practice improves the quality of education offered by institutes of higher learning. It also sends the message that reflective learning is important for both students and teachers, and that everyone is committed to supporting it.

Another common facilitator to performing deep self-reflection was that instructors need to provide guidance to students before starting the reflection process. Our review has revealed that students in most studies were reflecting at a superficial level. Therefore, educators must not assume students know how to reflect. Reflection is not easy, and for many students it is not natural. Students, particularly those in the first year of their undergraduate degree, require guidance on how to be reflective. Educators thus need to think strategically and logically about how to engage students in reflection. For junior students, a structured reflection guide could be used to aid their process in self-reflection compared to their senior counterparts who have some experience in reflection where they could engage in more "free form" reflection (Pee et al., 2002). Moreover, educators could further support students by providing sufficient relevant reference materials before the start of their reflection (Burnett and Akerson, 2019). Providing written or textual exemplars can also assist students to understand the distinctions between levels of reflection and enlighten them as to how to critically reflect (Moon, 2013). That is students should be supported *via* a scaffolding process where educators developed structured activities that progressively increase students' abilities to engage in deep reflection while gradually reducing teachers' guidance (Coulson and Harvey, 2013). However, there are various teaching and epistemological structures in connection to reflective practice and with this a need to recognize that not all teachers are disposed to reflect, nor are they able to effectively teach critical reflection (Kreber and Castleden, 2009). Therefore, at the organizational level, higher educational institutions could better support educators especially junior teachers through provision of training and peer support. As a start, teachers could be trained to improve their understanding toward reflection assessment, especially with regards to potential issues of consistency, appropriate assessment criteria, and fairness (Chan and Lee, 2021). In addition, pertaining to certain reflection formats such as oral discussion, our review has demonstrated that if educators choose this format for students, they will need to be trained to modulate discussion for large class size, be equipped with the skills to conduct FGDs effectively, and be comfortable to train students to be moderators for FGDs.

Another common barrier to performing deep self-reflection was the imbalance in power relationship between instructors and students which may hinder sharing. Power exists in all human relationships in diverse ways and extents. This includes teacher-student interactions. Teacher use of power in learning environments warrants continued attention because it strongly influences teacher-student relationships, students' motivation to learn, and learning outcomes (Mottet et al., 2006; Schrodt et al., 2008; Fin, 2012). Paying attention to power in learning environments is important when students are asked to self-reflect. Other than allowing students to feel less restricted when it comes to having to share their reflection with teachers, power-sharing could promote deep reflection. To facilitate this, educators could create a conducive environment by encouraging students to share their reflective thoughts freely and openly. Moreover, educators could promote the norm of sharing at an

equal level in their classroom by sharing their own reflective thoughts too. The goal would be to create a critical and yet democratic classroom environment in which all members have equal opportunity to speak their mind, all members respect other members' rights to speak and feel safe to speak (Breunig, 2005).

The various facilitators and barriers identified in this review served as consideration in promoting reflective practice in public health higher education. These factors are often interconnected and remind us of the need to promote deep self-reflection across all levels from students to teachers and even educational institutions. Because perceptions of learning environments varied between institutions, programs, teachers and students, efforts to evaluate the implementation feasibility of these facilitators and barriers need to take place across the different levels. Most of these facilitators and barriers were clustered at the teacher-pedagogical and student learning levels, hence these should be targeted first before moving to the institutional and sociocultural factors which might require more time to change. As a start, peer ambassadors or champions could be appointed at the student level to change the common perception that performing deep self-reflection was time consuming. If student ambassadors or champions work collaboratively with their peers, it might be easier to forge meaningful connections and to modify their perceptions (Gartland, 2014). Similarly, at the teacher level, faculty learning communities could be set up for like-minded educators to advocate on the importance of reflection and to share their experience on balancing the power relationship between instructors and students. They could thus serve as a valuable resource of information and support for peers to learn new pedagogical skills from, and to share meaningful instructional practice in a safe space (Lapoint, 2021).

Strengths and Limitations

There were several strengths and limitations of our current review. One strength was the moderate to high quality of the included studies, with more than 90% of the included studies having at least half of the criteria assessed to be at low risk of bias. Another strength was the use of both meta-analysis and meta-synthesis results to achieve methodological triangulation. Nevertheless, there were also a few limitations. As there were at most four studies for each outcome in our meta-analysis, the small number has limited our ability to estimate the possible correlation among the four outcomes (understanding of public health related topics, communication skill, academic skill, and career prospect). Publication bias could not be excluded since there was a likelihood that interventions without significant or positive evaluation results were not published. Moreover, as we focused largely on electronic databases, many self-reflection activities conducted by Schools of Public Health or universities might not be reported in journals or be published. The low T^2 and moderate to high I^2 from the heterogeneity test of each outcome indicated that the total observed variance was low and there was more heterogeneity than sampling error from the studies. While no publication bias was detected for the outcomes on understanding of public health related topics, communication skill and academic skill, we could not rule this out for career

prospect where the Egger test p -value was 0.004. The estimated standard error from some studies were indeed larger and such studies carried lower weight when they were pooled with other studies for the same outcome. Despite this, all studies reported the same direction for each of the outcomes which aligned with our pooled results. In addition, great care was taken to ensure that we included only studies that measured similar outcome and the random effects models were used. Another limitation was a general lack of reported negative outcomes especially for the format of portfolio. It is also important to note that reflection is not solely a cognitive process, but also an affective process where emotions and feelings are often expressed. While the cognitive aspects of reflection might potentially be objectively measured or quantified, the same cannot be said for the emotional aspect. Because reflection is a metacognitive process, the existing formats of outcome assessment described in this review are probably indirect rather than direct measurements of self-reflection. Despite this, our review has elicited the various facilitators and barriers to performing deep self-reflection based on the common formats of reflection used in public health. Awareness of these findings will be important to increase understanding about the reflection process, develop effective educational strategies, and to better interpret assessment results to promote deep learning in public health students.

CONCLUSION

In conclusion, to the best of our knowledge this is the first systematic review to illustrate the various self-reflection formats used in public health education. Using meta-analysis and meta-synthesis, we have achieved the study objectives of (1) describing the range of self-reflection formats used in public health undergraduate education, (2) comparing the level of reflectivity and outcomes of self-reflection according to the common formats of self-reflection used, and (3) comparing the facilitators and barriers to deep self-reflection based on the common formats of self-reflection used. Most students were not engaging in reflection at a deep level. While there was an overwhelmingly positive outcomes across the reflection formats, there was in general a lack of reported negative outcomes especially for the format of portfolio. Both meta-analysis and meta-synthesis results revealed enhanced self-confidence, professional identity, and professional development as well as improved understanding of public health related topics. Future educational programs should consider the common facilitators to deep self-reflection, i.e., advocacy on the importance of reflection by instructors and provision of guidance to students as well as the common barriers, i.e., perception by instructors/students to be time consuming or unimportant as well as the imbalance in power relationship between instructors and students. Because perceptions of learning environments varied between institutions, programs, teachers and students, efforts to evaluate the implementation feasibility of these facilitators and barriers need to take place across the different levels. As a start, peer ambassadors or champions could be appointed at the student level to change the common perception that performing deep self-reflection

was time consuming. Similarly, at the teacher level, faculty learning communities could be set up for like-minded educators to advocate on the importance of reflection and to share their experience on balancing the power relationship between instructors and students.

DATA AVAILABILITY STATEMENT

The original contributions presented in the study are included in the article/**Supplementary Material**, further inquiries can be directed to the corresponding author.

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AUTHOR CONTRIBUTIONS

All authors contributed significantly to the drafting and revision of the manuscript, and have read and approved the final manuscript.

SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: <https://www.frontiersin.org/articles/10.3389/feduc.2022.938224/full#supplementary-material>

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