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Review

The use of 3D video in medical education: A scoping review

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A R T I C L E I N F O

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A B S T R A C T

Objectives: The use of 3D video in medical education has not been fully explored. This article aims to review the evidence on 3D video currently presented in the medical education literature, including its impact on curriculum activities, to reference future research in this field.
Methods: According to the guidelines of Arksey and O'Malley, the authors used a systematic search strategy (the last search was in December 2022) to search nine literature databases published in English, and only primary studies were included. Two authors independently screened all articles based on the eligibility criteria and performed a thematic analysis of the included literature.
Results: Of 1,302 articles identified, 23 were included for insights into how opportunities for 3D video in medical education are created, how they are experienced, and how they influence and manifest behavior demonstrated partial congruency. Three themes were identified: (a) advantages of using 3D video in medical education; (b) the effect of using 3D video in medical education on students' academic achievement and ability; and (c) students' experience of 3D video in medical education.
Conclusions: The application of 3D video in medical education has won the support of most students and educators. However, the effect of using 3D video in medical education is still controversial. Medical educators should combine the curriculum's characteristics, the students' learning situation, and the existing educational resources and choose to use them after careful consideration.

What is known?

- Learning through video is an efficient way to study.
- The development of information technology makes it possible for 3D video to be widely used.
- Using 3D video in medical education is supported by most students and educators.

What is new?

- Thus far, many kinds of 3D videos have been used in medical education. Some research results showed that 3D video teaching could improve students' academic performance. In contrast, some research results showed that 3D video teaching did not lead to significant academic improvement and was even not as good as traditional 2D video teaching.
- Most students' experience of 3D video in medical education was positive.

1. Introduction

The status of learning through video in medical education has grown exponentially in the past decade [1,2]. It has been found that educational videos are successful audiovisual support for learners [3–14]. Therefore, current learners can skillfully meet their learning needs through video. For example, teaching videos can help solve the cognitive load problem of long-term teaching in a network environment and effectively overcome the adverse effects of class expansion, course expansion, student learning time pressure, and teacher shortages [15]. Another aspect that makes educational videos a powerful learning and teaching tool is that they provide diversity and present learning materials in a simple

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and easy-to-understand way [16–20]. Otherwise, in face-to-face teaching, verbal expression is a challenge [21].

3D video is an essential part of educational videos, and it is becoming increasingly popular in medical education, especially during the new coronavirus pandemic. The COVID-19 pandemic has hindered regular face-to-face teaching in traditional classroom environments and prevented adequate practical learning [22–31]. Teachers must work hard to use existing technology to provide high-quality guidance on medical content during home isolation [26,32–34]. 3D video may become a new medium, providing valuable learning resources for practical teaching outside the laboratory [16,35–37]. There is ample evidence that 3D video helps health students better understand complex and detailed objects, is conducive to the development of brain schemas, and can improve long-term memory and meaningful internalization of learning concepts [20,38–41]. According to reports, students believe that using 3D video in the classroom makes learning more attractive and enjoyable and increases their participation in classroom activities [42,43]. With the trend toward the availability of powerful hardware and software, we predict that the use of 3D video for teaching purposes will continue to grow.

3D video is generally useful and considered to have good value in medical education [1,44]. Ensuring the use of appropriate quality 3D video to help students learn and optimize their learning experience is often a challenge [45]. Therefore, we started a review of the research question: What information has been published about 3D video in medical education? We intend to provide comprehensive information about 3D video teaching to the medical education community to provide references for future applications in this field.

2. Methods

We expected this review to contain different types of articles, so a broad, flexible and comprehensive method was used to identify and summarize article information. Scoping review was considered to be an appropriate method to achieve this goal. In this method, the article content was included regardless of the type or quality of the article [46,47]. It could avoid the limitations of absolute systematicity and accurately present the article information. A systematic approach was adopted with the scoping review, including a comprehensive, transparent, and reproducible search strategy. Measures needed to be taken to reduce errors, increase reliability, and use structured methods to extract and present results. This scoping review followed the guidelines of Arksey and O'Malley [48].

2.1. Identifying the research question

The research questions of this scoping review are: (a) How is 3D video understood in the medical education literature, and (b) How does current empirical work describe 3D video?

2.2. Identifying relevant studies

In December 2022, we formed a search strategy under the guidance of a librarian and then searched nine related databases: Ovid EMBASE, Ovid PsychInfo, PubMed, Web of Science, Education Research Complete (EbscoHost), CINAHL with Full Text (EbscoHost), ERIC (Education Resources Information Centre via EbscoHost), The Cochrane Library, and Google Scholar. Search strategies included free text terms and medical subject headings (MeSH) combined with Boolean operators. An example search strategy for PubMed is provided in Table 1. The search was not restricted by date and included articles published online before printing. We conducted the last search on December 31, 2022.

2.3. Study selection

We searched for all possibly relevant papers from the database ($n = 1{,}302$) and downloaded and imported the detailed information of the papers into EndNoteX9 (Clarivate Analytics, Philadelphia, PA, USA). After identifying and removing duplicate samples ($n = 189$), JG and YC independently screened all headlines and deleted all non-English articles and articles that were clearly out of scope ($n = 501$). JG and FM independently screened the abstracts of all remaining papers ($n = 612$) to determine whether they were eligible for full-text review. When there was a disagreement, all the authors discussed until they reached a consensus. After abstract screening, JG and WL independently reviewed the full text of the included articles ($n = 179$). The eligibility criteria used to screen titles, abstracts, and full texts are listed in Table 2. After a full-text review, 23 articles met the eligibility criteria. According to the PRISMA guidelines, a search and selection process flowchart is provided (Fig. 1).

2.4. Charting the data

We developed the initial data extraction form and optimized it to map the data for all eligible studies and discussed what data were necessary to answer the research questions of this review. GJ and WL repeatedly read the 23 included articles and extracted data, including title, author names, publication year, continent, country, subject, the dominant feature of 3D video and students, length of 3D video, study design, sample size (n), and data collection method. The chart data presented are the final version after discussion and agreement (see Table 3 for the characteristics of the included studies). According to the accepted scoping review methodology, we did not evaluate the quality of the literature.

2.5. Collating, summarizing and reporting the results

We conducted a quantitative and qualitative thematic analysis of all qualified articles and undertook a fundamental quantitative analysis of publication year, geographical location, population studied, study type, subject, data collection method, main outcomes and dominant feature of 3D video to add contextual indications for qualitative synthesis. For qualitative thematic analysis, Braun and Clarke' six-step method was adopted: (a) familiarity; (b) generating original codes; (c) searching for themes; (d) reviewing themes; (e) defining and naming themes; and (f) proposing a report [66]. Two authors independently reviewed these articles to generate the initial code and then discussed the generation of emerging topics. Through discussions with the third author, we reviewed and improved this content.

3. Results

3.1. Overview of the review findings

The publication year of the 23 articles we included was from 2002 to 2022. We quantified the number of published papers each year and found that the number of publications has generally been increasing. A total of 19/23 (83%) articles were published after 2015 [22,23,35,38,40,49–62], and 2020 ($n = 4$) [53–56] ranked as the top year in terms of the number of published papers each year. Geographically, half of all articles originated from Europe. The studies are from various continents, including Europe ($n = 11$) [39,40,51,53–56,58–60,65], North America ($n = 4$) [23,50,62,63], Asia ($n = 4$) [49,52,61,63], South America ($n = 2$) [38,57], Africa ($n = 1$) [35], and Oceania ($n = 1$) [22]. With regard to sample size, 16 (70%) studies had a small sample size (≤100)

Table 1
Search strategy for PubMed.

No.	Syntax
1.	Three-Dimensional video* OR Three Dimensional video* OR 3-D video* OR 3D video*
2.	(Educational Measurement OR Education, Medical OR Education, Medical, Graduate OR Education, Medical, Undergraduate OR Education, Nursing OR Education, Nursing, Baccalaureate OR Education, Nursing, Associate OR Education, Dental OR Education, Pharmacy OR Education, Veterinary OR Education, Professional [MESH Terms]) OR (Health* OR Educa* OR teach* OR curriculum* OR train* OR Stud* OR Learn*)
3.	(Students OR Students, Health Occupations OR Students, Dental OR Students, Medical OR Students, Nursing OR Students, Pharmacy OR Students, Premedical OR Students, Public Health OR Clinical Clerkship[MESH Terms]) OR ((medica* or nurs* or physician assistant* or allied health or dent* or pharmac* or veterinary*) adj2 trainee*) OR (Clerkship* OR Graduat* OR Profession* OR Health Occupations Student*)
Combine	1 and 2 and 3

Table 2
Study eligibility criteria.

Inclusion criteria	Exclusion criteria
1. Published in English 2. Focuses on health professions students 3. Study of any design-quantitative or qualitative 4. Articles reported one/more aspect of 3D video in medical education 5. Primary studies	1. Articles without full text 2. Systematic reviews or review articles, letters to the editor, Books, chapters of books, conference papers, conference abstracts, white papers, dissertations or theses

[23,35,38,40,49,51,55–60,62–65], 6 (26%) had a moderate sample size (100–1,000) [39,50,53,54,62,64], and 1 (5%) had a large sample size (≥1000) [22]. All studies were empirical work. Twenty-two articles were quantitative studies [23,35,38–40,49–65], and 1 article was qualitative research [22]. The study designs were as follows: 8 cross-sectional [22,50,51,54,56,61,62,65] and 15 randomized controlled trials (RCTs) [23,35,38–40,49,52,53,55,57–60,63]. The participants ranged from first-grade to fifth-grade health profession students, including first-grade students ($n = 2$) [57,63], second-grade students ($n = 3$) [23,53,60], third-grade students ($n = 3$) [50,51,54], and third-grade and fifth-grade students ($n = 1$) [35]. Regarding 3D video, the length of 3D videos varied from 30 s to 30 min in 10 articles [35,38–40,50,52,54,57,60,63]. Another 12 articles did not report 3D video length [22,23,49,51,53,55,56,58,59,62,64,65]. Four articles required students to wear 3D glasses to watch a 3D video [38,53,59,61], and 4 required them to wear head-mounted displays or headset [49–52]. Nine articles reported interactive 3D video [22,39,52,55,56,58,59,64,65], and 1 article reported noninteractive 3D video [53].

3.2. The themes extracted from the review

We extracted three themes from the review: (a) advantages of using 3D video in medical education; (b) the effect of using 3D video in medical education on students' academic achievement and ability; and (c) students' experience of 3D video in medical education.

3.2.1. Theme 1: Advantages of using 3D video in medical education

Theme 1 was extracted from 17 studies [22,23,35,38–40,51,52,54,55,57,59–61,63–65]. 3D video in medical education has considerable advantages. Teaching videos reduced the teacher's verbal expressions and reduced the students' learning time [38]. Traditional two-dimensional video has difficulty showing the complex anatomical structure in medicine and may miss essential learning information, which is not conducive to the comprehensive grasp of learning materials [38,39]. In addition, two-dimensional images may reduce the visual effect compared to natural vision [64]. 3D video could be depicted by the binocular parallax of the image entering the left and right eyes [59]. 3D video could provide depth perception and more detailed and accurate information [38,63], allowing students to feel immersed, improving students' visual perception and spatial capabilities [39], reducing students' misunderstandings during learning [40], and motivating students to continue and actively learn [52,61].

3D video in medical education was relatively easy to obtain. With the continuous improvement and innovation of information technology in the past few decades, the availability of powerful hardware and software, such as high-resolution photography, computer processing, and dual video projection, has made three-dimensional visualization possible [40,52,55,57,59,65]. Some 3D videos could be provided to students through a learning management system (such as Moodle), and some could be obtained for free on the internet and support multiple languages (such as English, Russian, and Hebrew) [60].

3D video in medical education could meet special needs. Students' on-site learning opportunities might be affected in the actual teaching process. On the one hand, maintaining the traditional training room requires considerable expenses and resources [35]. On the other hand, the increase in physical distance (such as the isolation of students from home during the new coronavirus pneumonia pandemic) and the limited class size prevented some students from going to the field to study [22,23], resulting in restrictions on the implementation of the learning plan for teacher face-to-face guidance [57]. Therefore, distance teaching methods with 3D video added could often be used to solve these problems so that students could acquire learning knowledge and skills in any place rather than in a limited environment [22,23,51,52,57]. In addition, in some special medical teaching, such as vaginal surgery, it was difficult for students to understand the anatomy and surgical principles involved due to the small scope of surgery and limited visuals [65]. Therefore, the use of e-learning methods such as 3D video provided students with more possibilities to observe the surgical process efficiently [59].

3.2.2. Theme 2: The effect of using 3D video in medical education on students' academic achievement and ability

Theme 2 was extracted from 11 studies [22,38–40,52–55,57,63,64]. Numerous studies showed that the use of 3D video in medical education could improve students' academic performance and ability. Motsumi et al. found that students who use 3D video teaching had a better understanding than those who use traditional teaching methods [35]. Prinz et al. found that, compared with the 2D video teaching group, 3D video improved students'

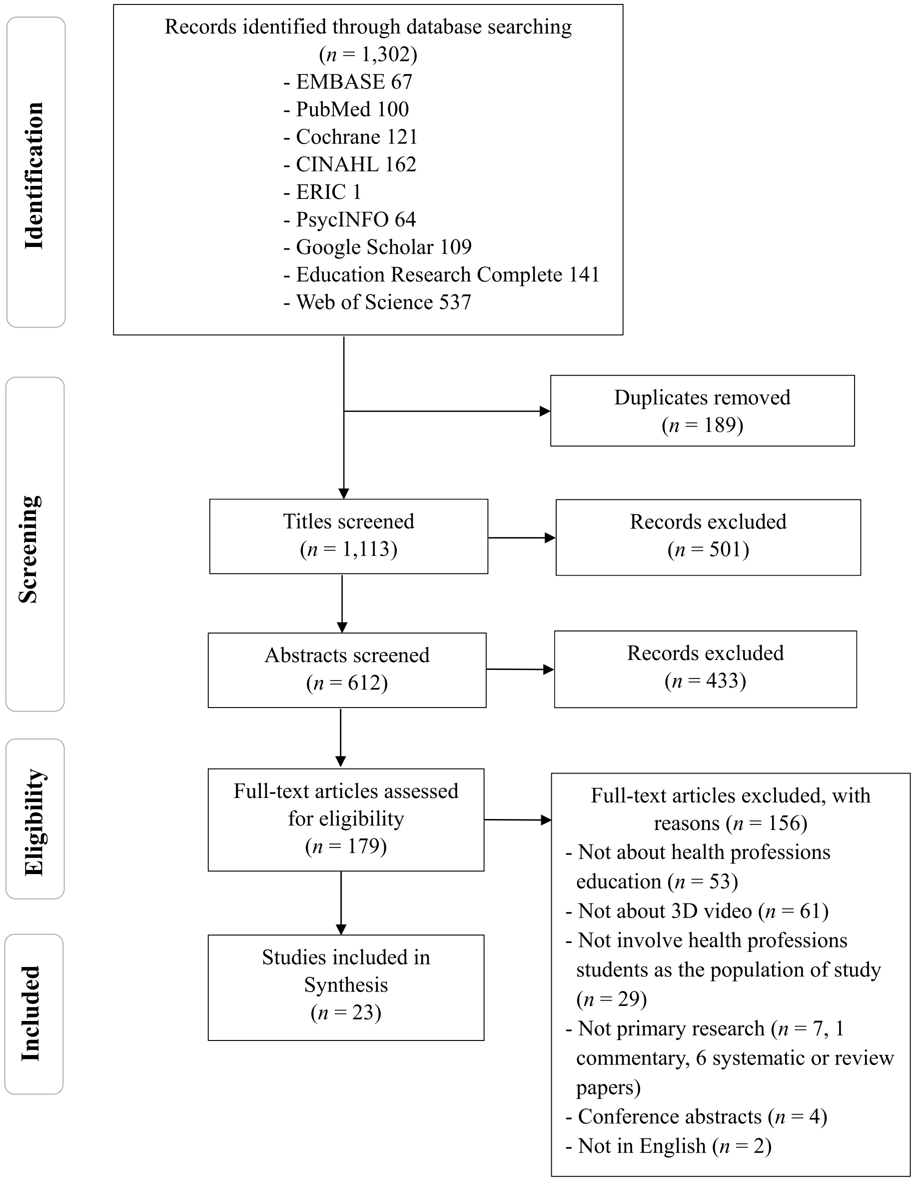

Fig. 1. PRISMA2020 flow diagram for the study.

spatial understanding ability and theoretical knowledge achievement. Among them, the improvement in spatial ability was the most obvious [39]. In addition, students in the 3D video teaching group scored higher in anatomical relationships, clinical reasoning, and general precautions [53]; the students' score for 3D video teaching was 8.9/10, while the score for 2D video teaching was only 5.9/10 [54]; in terms of periodontal disease education and knowledge recall, students in the 3D video group performed better than those in the 2D video group [63]. 3D video teaching improved students' understanding of complex structures [22,52,62]. In addition, compared with men, women had a greater advantage in receiving 3D video teaching because female students achieved significantly better results in all types of tests [39].

Some studies showed that 3D videos did not improve students' academic performance. 3D video in medical education did not always bring a favorable teaching outcome. Daly et al. found that although students generally tend to use 3D video teaching, this was not reflected in students' test scores (students' test scores are roughly similar between groups), and no strong evidence has been found to support 3D video teaching [40]. Research by de Sena et al. showed that, compared with the self-training model based on 2D video teaching, students exposed to the self-training model based on 3D video teaching for a short time performed worse in theoretical and practical cardiopulmonary resuscitation (CPR) tests. However, the CPR performance scores of both groups of students improved [57]. There was no significant difference between 2D video teaching and 3D video teaching in the efficiency and accuracy of using endoscopes for surgery [55]; in terms of diagnostic accuracy, the 3D video group also showed no advantage [38]. For experienced individuals, the 3D video did not significantly improve their laparoscopic skills [64].

3.2.3. Theme 3: Students' experience of 3D video in medical education

Theme 3 was extracted from 9 studies [49–52,56–58,62,64]. The positive feedback on 3D video teaching of students was as follows. The students said that 3D video learning was more enjoyable [50,58,62], and they appreciated the 3D video of different

Table 3
Characteristics of included studies.

Author, Year,Country	Subject	Study design	Sample size (*n*)	Data collection method	Main findings
Yuri et al., 2022 [49] Japan	Suturing in open surgery	RCT	3D video group: 19 ; 2D video group: 19	Questionnaire , Test	The posttest scores of the 3D video group improved significantly from the pretest ($P < 0.001$); Students thought 3D video regarding manipulating surgical instruments was more helpful than 2D video.
Vrillon A et al., 2022 [50] USA	Lumbar puncture	Survey	168	Questionnaire	Participants rated the 3D video favorably; For 3D video, inexperienced participants displayed higher satisfaction and perceived benefit than experienced individuals ($P < 0.05$).
Wilkerson et al., 2022 [51] France	Biomedical engineering	Survey	56	Questionnaire	89% of the students believed the 3D video provided the opportunity to work at their own pace and were an appropriate length; 43% of the students believed the 3D video was an acceptable alternative to in-person labs; Two-thirds of students reported feeling some form of discomfort while viewing the 3D video.
Schmidt et al., 2021 [22] Australia	Anatomy	Survey	5,438	Online feedback	3D video teaching improved students' understanding of complex structures.
Sadid-Zadeh et al., 2021 [23] USA	Fixed prosthodontics	RCT	94; 3D video group: NR; Traditional teaching group: NR	Questionnaire, Test	63% of students opined that 3D video was more effective than the conventional method; 80% of students felt that 3D video was effective in maintaining physical distance during skill evaluations.
Chao et al., 2021 [52] China	Nursing skills	RCT	3D video group: 22; 2D video group: 23	Questionnaire	Participants' average satisfaction score in the 3D video group was significantly higher than in the comparison group ($P = 0.026$); 3D video teaching improved students' understanding of complex structures.
Bernard et al., 2020 [53] France	Anatomy	RCT	3D video group: 91; 2D video group: 84	Questionnaire, Test	Students in the 3D video teaching group scored higher in anatomical relationships ($P = 0.004$), clinical reasoning ($P = 0.023$), and general precautions ($P = 0.07$) than those in the 2D video teaching group; Most students (85%) supported the use of 3D video in their normal teaching as a complementary tool; Some students reported that they had slight headaches and nausea while watching 3D videos, and switching between shots would cause visual discomfort.
Jacquesson et al., 2020 [54] France	Anatomy	Survey	195	Questionnaire	All students were satisfied with 3D video; The students' score for 3D video teaching was 8.9/10, while the score for 2D video teaching was 5.9/10.
Ten Dam et al., 2020 [55] Netherlands	Endoscopic sinus surgery	RCT	3D video group: 13; 2D video group: 17	Questionnaire	There was no significant difference between 2D video teaching and 3D video teaching in the efficiency and accuracy of using endoscopes for surgery; 3D video was subjectively rated significantly better.
Fairen et al., 2020 [56] Spain	Anatomy	Survey	24	Questionnaire	Students thought that using 3D video motivated learning more, and they were satisfied with the intuitive user interface.
De Sena et al., 2019 [57] Brazil	Cardiopulmonary resuscitation	RCT	3D video group: 23; 2D video group: 22	Test	The CPR performance scores of both groups of students improved; Students showed a clear preference for using 3D video instead of traditional 2D video as a form of self-training.
Motsumi et al., 2019 [35] Botswana	Surgical skills	RCT	3D video group: 45; traditional teaching group: 45	Questionnaire, Test	3D video teaching was associated with better understanding than traditional teaching ($P < 0.001$); All students recommended the adoption of 3D video.
Harrington et al., 2018 [58] Ireland	Minimally invasive surgery	RCT	3D Zideo group: 10; 2D video group: 10	Test	More than half of the respondents said they would recommend 3D videos to others; There was a need to improve the quality of the 3D video, improve the user interface and solve technical obstacles.
Harris et al., 2018 [59] UK	Robotically assisted surgery	RCT	90; 3D video group: NR; 2D video group: NR	Practical test	There was no significant difference between the 3D video group and 2D video group.
Chhaya et al., 2017 [38] Argentina	Vitreoretinal surgery	RCT	3D video group: 52; 2D video group: 48	Answer questions	The 3D video group performed better than the 2D video group ($P < 0.05$) on anatomy comprehension questions; in terms of diagnostic accuracy, the 3D video group showed no advantage.
Drummond et al., 2017 [60] France	Cardiopulmonary resuscitation	RCT	3D video group: 41; 2D video group: 41	Practical test	3D video was not superior to 2D video to pretrain medical students in the management of a cardiac arrest.
Daly et al., 2016 [40] UK	Physiology	RCT	3D video group: 27; 2D video group: 27	Questionnaire	Students' test scores were roughly similar between groups. Students tended to use 3D video learning.
Huang et al., 2016 [61] China	Anatomy	Survey	230	Questionnaire	There was no significant difference regarding the acceptance of 3D video learning between males and females.
Hayward et al., 2016 [62] Canada	Diagnostic reasoning	Survey	322	Questionnaire	The students thought 3D video was more enjoyable; Students' criticisms mainly focused on the technical aspects of the 3D video.
Dhulipalla et al., 2015 [63] India	Periodontal health education	RCT	3D video group: 40; 2D video group: 40	Test	In terms of periodontal disease education and knowledge recall, students in the 3D video group performed better than those in the 2D video group.
Votanopoulos et al., 2008 [64] USA	Laparoscopic training	RCT	3D video group: 25; 2D video group: 25	Practical test	For experienced individuals, the 3D video did not significantly improve their laparoscopic skills; 20% of inexperienced participants and 9% of experienced participants complained of discomfort when wearing helmet-mounted headsets.
Prinz et al., 2005 [39] Austria	Ophthalmic surgery	RCT	3D video group: 90; 2D video group: 82	Questionnaire, Test	3D video improved students' spatial understanding ability ($P < 0.0001$) and theoretical knowledge achievement ($P < 0.03$) more than 2D video;

Table 3 (*continued*)

Author, Year,Country	Subject	Study design	Sample size (n)	Data collection method	Main findings
Jha et al., 2002 [65] UK	Gynaecological surgery	Survey	12	Questionnaire, Test	Compared with men, female students achieved significantly better results in all types of tests. 83% of students agreed that the 3D video improved their understanding of the relevant anatomy; 75% of students thought 3D video teaching was useful.

Note: RCT = randomized controlled trial. NR=Not Reported.

anatomical structures, such as the blood flow in the heart, the movement of air into the lungs, or the movement of different parts; they thought that using 3D video motivated learning more, they were satisfied with the intuitive user interface [56], and they considered 3D video regarding manipulating surgical instruments to be more helpful than 2D video [49]. In addition, the students showed a clear preference for using 3D video instead of traditional 2D video as a form of self-training because they remained interested in 3D video for a longer time [57]. More than half of the respondents said they would recommend 3D videos to others [58].

The negative feedback on 3D video teaching of students is as follows. Some students reported that they had slight headaches and nausea while watching 3D videos, and switching between shots caused visual discomfort [51,53]. Similarly, in a study by Votanopoulos et al., 20% of inexperienced participants and 9% of experienced participants complained of discomfort when wearing helmet-mounted headsets [64]. In addition, in Hayward's research, students' criticisms mainly focused on the technical aspects of the 3D video [62]. Several students encountered difficulties interacting with the 3D video. Four students felt that the 3D video was too long, and it took an hour to complete [62]. Students reported the need to improve the quality of the 3D video, improve the user interface and solve technical obstacles [58].

4. Discussion

To the best of our knowledge, this is the first scoping review of 3D video in medical education. The review shows a broad consensus on why 3D video can be continuously tried and used in the field of education, mainly based on the advantages of 3D video itself, the development of information technology and the solution of practical teaching needs. However, the application effect of 3D video in medical education is controversial. Some research results show that 3D video teaching can improve students' academic performance. In contrast, some research results show that 3D video teaching does not lead to significant academic improvement and is even worse than traditional 2D video teaching. Most students' experience of 3D video in medical education is positive, while some negative feedback exists, such as discomfort and vertigo in watching a 3D video.

As a novel and practical teaching tool, 3D video can give users more depth perception [38,64]. Studies have proven that performance is impaired by 35%–100% when traditional 2D imaging systems are used for surgical tasks [64], and 3D videos have proven to be an essential and valuable supplement to traditional surgical video teaching. It is suggested to use similar 3D videos in teaching various other medical topics [39]. However, there are a few caveats when using 3D video teaching. First, not all participants benefit from 3D video teaching. Some studies have shown that for inexperienced individuals, 3D video improves students' performance in laparoscopic skills; however, for experienced individuals who are already familiar with laparoscopic skills, 3D video does not significantly improve laparoscopic skills [64]. Second, if the video is not designed within the framework of structured learning, students are often misled. There is a need to provide a clear learning framework to reduce misunderstandings in students' learning process [40]. Third, 3D videos can only promote the development of learners' spatial awareness if they find them useful and easy to use [61]. Students chose the combination of 3D video teaching and traditional teaching as their preferred teaching method, followed by 3D video teaching, and last by traditional teaching, suggesting that they would want to retain something from the traditional teaching method, rather than replacing it entirely with 3D video [35].

The results of this study will impact front-line teachers, curriculum designers and curriculum supervisors in medical education. Educators should prepare to have keen insight into students' potential reactions to 3D video teaching, whether positive or negative and whether cognitive or emotional. In fact, 3D videos provide sense and logic for some complex medical knowledge by combining appropriate verbal descriptions with visual animation information [1,20]. According to Mayer's cognitive load theory, learners can master more information if two channels (auditory and visual information) are presented simultaneously [67]. However, caution should be exercised before generalizing that all 3D video is more effective than 2D video. For example, when learners passively learn from 3D videos and do not fully participate in learning activities, they may have misunderstandings during video processing [68]. According to the research of Schwan and Riempp, simple interaction can speed up the learning process [69]. Interactivity helps students allocate their attention and cognitive resources to relevant parts of the 3D video instead of being distracted by irrelevant information [70].

Although relevant information was systematically collected in this review about 3D video in the existing health professional education literature, this work still has limitations. For example, although we conducted a comprehensive database search, we may still have missed some related articles. This review only included English-language literature to reduce translation errors, resulting in the exclusion of related papers published in other languages. Under the conventions of scoping review, we did not formally evaluate the quality of the evidence included in the literature, and a systematic review may solve this problem. In addition, since the anatomy course is representative in the included literature, the representativeness of this review to all health professional courses is in question. Nevertheless, we trust that this work provides some insights that can reference future research to promote and evaluate the application of 3D video in medical education.

3D video teaching makes medical students have a great interest in digital technology, and it is relatively easy to access. Nevertheless, the cost of developing and updating 3D video is not low [60], resources from various departments are needed for its establishment, and its impact on clinical ability needs to be objectively evaluated [70]. Future research should continue to question whether 3D video teaching is the most cost-effective method, which will require long-term follow-up of blind prospective trials with larger sample sizes. Presumably lightweight, portable devices (such as earphones) can be developed at an affordable price in the future. In that case, students will have the opportunity to train and learn regardless of geography and time [52,61].

5. Conclusion

The use of 3D video in medical education has become a hot trend and is also in line with the development of the times. The application of 3D video in medical education has won the support of most students and educators, and it has also brought many gratifying results. However, no teaching method is perfect, and 3D video still has some areas to be improved in medical education. Medical educators should combine the curriculum's characteristics, the students' learning situation and the existing educational resources and choose to use them after careful consideration. We believe that with the continuous improvement of educational tools, the teaching effect of 3D video in the future will be fully improved. It is recommended that in future research, the effectiveness of 3D video in medical education and the detailed implementation plan of using 3D video for teaching be fully explored to provide medical educators with more scientific and reliable evidence.

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Data availability statement

Data sharing not applicable to this article as no datasets were generated or analyzed during the current study.

CRediT authorship contribution statement

Juan Guo: Conceptualization, Methodology, Validation, Formal analysis, Data curation, Writing - original draft, Writing - review & editing, Project administration. **Qingmin Guo:** Conceptualization, Methodology, Validation, Formal analysis, Data curation, Writing - review & editing, Supervision, Project administration. **Mei Feng:** Conceptualization, Methodology, Validation, Formal analysis, Data curation, Writing - review & editing. **Shanshan Liu:** Conceptualization, Methodology, Validation, Formal analysis, Data curation, Writing - review & editing. **Wenping Li:** Conceptualization, Methodology, Validation, Formal analysis, Data curation, Writing - review & editing. **Yuzhen Chen:** Conceptualization, Methodology, Validation, Formal analysis, Data curation, Writing - review & editing. **Jinmei Zou:** Conceptualization, Methodology, Validation, Formal analysis, Funding acquisition, Writing - review & editing, Supervision, Project administration.

Declaration of competing interest

The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.ijnss.2023.06.006.

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