

Systematic Review

Methods and Target Values Used to Evaluate Teaching Concepts, with a Particular Emphasis on the Incorporation of Digital Elements in Higher Education: A Systematic Review

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Abstract: Previous evaluations of teaching quality have not considered the integration of digital elements. This systematic review was conducted in accordance with the PRISMA guidelines and offers a critical examination of the integration of digital elements in university teaching quality evaluations. The objective is to provide a comprehensive and systematic overview of the methods and target values used for special attention on the incorporation of digital elements in teaching concepts. This review analyzed 22 articles published between 2004 and 2023 from a pool of 11,851 manuscripts. The studies were classified into evidence levels A to C based on the clarity of quality criteria and documentation of measurement instruments. The findings indicate a significant gap in comprehensive quality criteria and instrument references. Self-developed questionnaires and performance examinations were prevalent, mostly classified under the lowest evidence level (C). A limited number of studies focused on psychological outcomes and the evaluation of digital teaching concepts, fulfilling all criteria for the highest evidence level (A). The results indicate a focus on using open-ended questions, interviews, and feedback mechanisms to gain insights into students' perceptions, which are essential for refining teaching concepts. There is a need to develop and validate evidence-based measurement techniques to better accommodate digital elements integration in teaching evaluations for future university pedagogy enhancements. The findings of this review provide a robust foundation for this purpose. This systematic review has been registered on INPLASY (INPLASY202460060).

Keywords: evaluation; digital tools; teaching; university

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1. Introduction

In recent years, digital teaching elements and learning modalities have become increasingly important in higher education. The coronavirus pandemic further accelerated the adoption of digital teaching, making it even more prevalent. This trend has persisted, with digital teaching methods now firmly incorporated into university pedagogy, extending beyond the pandemic period [1,2].

Distinct educational modalities include 'blended learning', 'flipped classroom', 'e-learning', and 'hybrid teaching'. According to Ødegaard et al. [3], 'blended learning' involves a combination of asynchronous online and synchronous on-site teaching. 'Flipped classroom' refers to the use of online components as preparatory work for subsequent units, with questions addressed or prearranged materials discussed during the on-site segment of the course. In contrast, 'e-learning' refers to the entirety of the course being conducted online as a structured concept. Communication between students and lecturers is also facilitated digitally. In the context of 'hybrid teaching', a subset of students participates in synchronous course activities both on-site and online. It is crucial to distinguish 'emergency remote teaching' (ERT) from the carefully planned and structured frameworks of university teaching, which are designed well in advance of implementation [4]. This refers to courses

that were quickly shifted to fully online instruction due to emergency circumstances, such as the coronavirus pandemic, but later returned to in-person instruction on site. The sudden transition to online teaching during emergency remote teaching (ERT), which was required by local restrictions, resulted in a significant increase in the use of digital components. Various digital elements, such as quizzes, game formats, videos, and podcasts, were extensively used in the classroom. Students generally expressed positive perceptions of their integration into classroom practice [5].

Nevertheless, in order to reap the benefits of the integration of digital elements in teaching, it is imperative that digital elements be incorporated into the methodology and didactics of the teaching concepts in a systematic and integrated manner. The efficacy of this approach and the impact of digital elements can be gauged through the application of appropriate methodologies and the assessment of designated target values.

Previous meta-analyses have demonstrated the benefits of incorporating video materials in interactive learning environments [6]. While the efficacy of diverse pedagogical approaches, including blended learning, flipped classrooms, and e-learning, has been investigated [3] and specific studies have examined digital pedagogical strategies in fields like physiotherapy [3] and nursing education [7], there is a paucity of rigorous research focusing on the evaluation of individual digital elements within teaching methodology and curricula via course evaluations. The criteria employed in course evaluations, a common method for assessing teaching quality in higher education, often lack the requisite specificity to evaluate the effectiveness of digital components within teaching approaches [8,9]. This underscores the pressing need for research that develops and applies more sophisticated evaluation methods and target values for digital elements in course evaluations, ensuring their meaningful contribution to educational outcomes and teaching quality. Despite the increased adoption of digital elements in university pedagogy, particularly following the coronavirus pandemic, there remains a significant gap in the research literature regarding the systematic evaluation and optimization of these components within structured teaching methodologies.

The purpose of this review is to provide a comprehensive overview of the methods and target values used to evaluate teaching concepts, with a particular emphasis on the incorporation of digital elements in higher education.

2. Methods and Material

This systematic review follows the PRISMA guidelines [10] and includes (randomized) controlled trials, pilot studies, and cohort studies that investigate a teaching concept integrating digital elements in higher education. This systematic review has been retrospectively registered on INPLASY (INPLASY202460060).

Sports science has unique characteristics due to its physical nature. The curriculum includes practical sports courses and traditional lectures and seminars, requiring a different approach with the use of digital elements. It also includes modules that align with content areas found in other academic programs, such as statistics, health, nutrition, medicine, biology, management, psychology, and education. This dual aspect, which requires a nuanced integration of digital resources, presents specific challenges and opportunities in sports science education. In order to address this aspect, only university subjects related to the teaching of sports science were included.

The inclusion criteria, defined as (1) to (5), are specified below:

1. Participants had to be students enrolled in universities or universities of applied sciences, taking courses related to sports science, such as anatomy, exercise science, biology, biomechanics, health sciences, management, medicine, physiology, psychology, physical education, or statistics. Programs unrelated to sports studies, such as art or music, were excluded.

2. The intervention must have included a comprehensive teaching concept implemented over a minimum of one semester, integrating digital components such as gaming or quiz formats, videos, podcasts, and an explanation of their use, such as in a blended learning context.
3. The study's outcomes were required to include precise target values and the instruments used to measure them, as described in the scholarly publication. Outcomes related to 'digital competency' or 'digital literacy' were excluded from the scope of this analysis, as they have been extensively examined in previously published systematic reviews [11,12].
4. The research design encompassed both quantitative and qualitative methods, inclusive of cross-sectional or longitudinal studies, as well as pilot studies.
5. Eligibility requires that studies are accessible as full-text articles published in scientific journals, with the language of publication being either German or English.

The literature search was conducted using several databases, including Scopus, Web of Science, Education Resources Information Center (ERIC), PubMed, and the 'FIS-Bildung' literature database (Education Information System in the Education Specialist Portal Pedagogy). The search syntax for title and abstract queries utilized the following terms in both German and English, without imposing restrictions on the publication period. However, the school context (school, pupil/s) was excluded:

- digital elements: online based, e-learning, online/digital learning/teaching/tool/education/method, e-teaching, technolog* tool, technology enhanced learning
- setting: university, higher education
- teaching concept: concept/s, approach/es
- evaluation: evaluat*, measur*, assessment, analysis, intervention, effectiveness, survey, test, exploration, impact, effect, investigation

The search was last conducted on 30 August 2023. The original and detailed search syntaxes for all databases can be found in the Supplementary Materials. Two independent reviewers (T.M. and A.H.) screened and determined study eligibility according to predefined inclusion criteria using Microsoft Excel and the Rayyan web platform [13]. Any discrepancies in study assessment between reviewers were collaboratively addressed, and reasons for exclusion were discussed, leading to a consensus on whether to include or exclude the study. The screening procedure is illustrated in Figure 1.

To account for the heterogeneity in the sophistication of the methods and target values, the authors developed a taxonomy with three levels of evidence (A to C). All included studies were classified into one of these three levels in order to assess the extent to which underlying evidence (theoretical framework based on references, quality criteria) supports the methods and target values. Studies that explicitly described both the quality criteria and references for the measurement instrument were assigned to evidence level (A). For evidence level (B), studies presented either the quality criteria or references of the method. For evidence level (C), studies lacked both quality criteria and references.

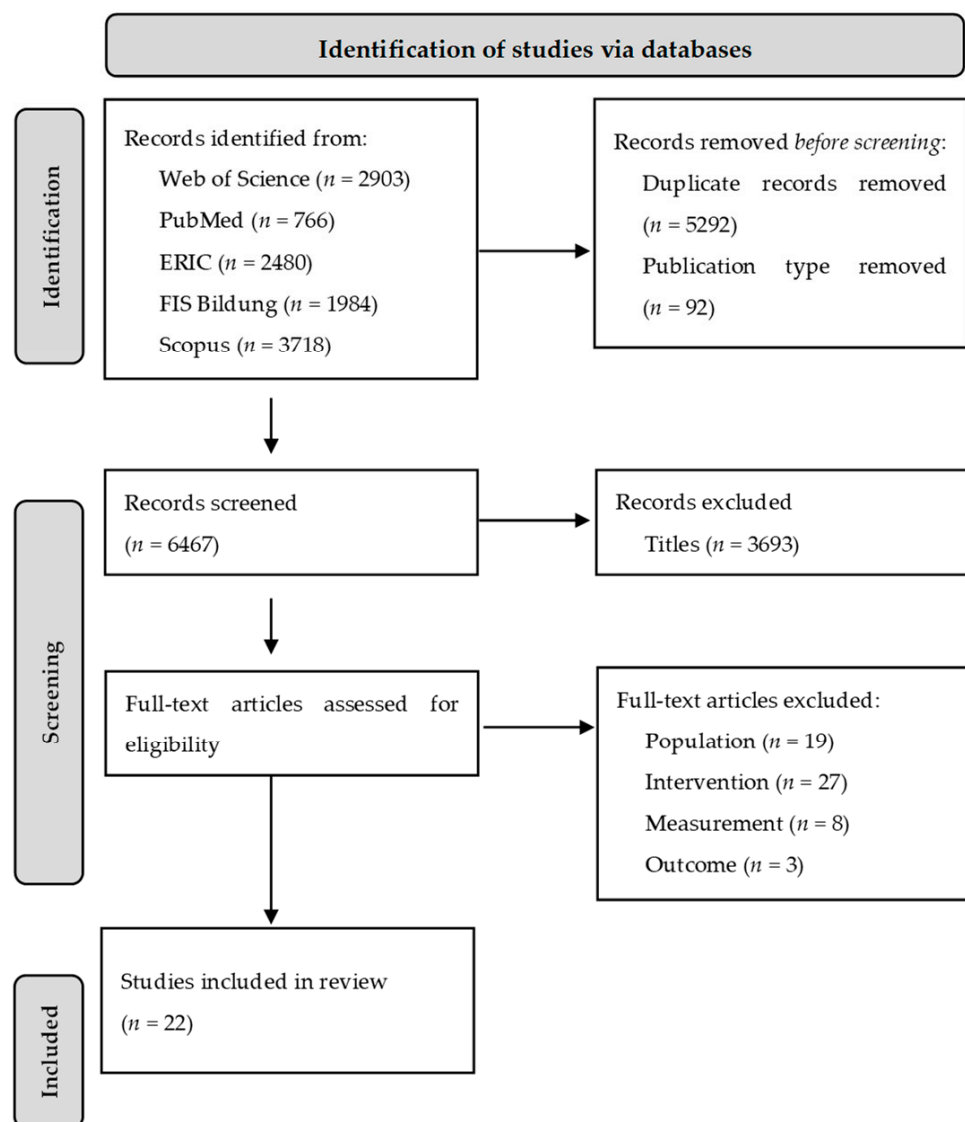


Figure 1. Screening process according to the PRISMA guidelines [10].

3. Results

Table 1 presents a detailed summary of the studies analyzed, including the authors, year of publication, country of implementation, sample size, intervention content, and target values.

Table 1. Detailed summary of the studies analyzed, including the authors, year of publication, country of implementation, sample, intervention content, and target values.

Authors (Year), Country [Reference Number]	Subject of Teaching, Population (N = Number of Students), Measurement Points (Mp), Study Design	Groups, Teaching Format, Didactical Integration, Digital Elements	Outcomes
Alabdulkarim (2021), Saudi Arabia [14]	Subject: health sciences education and research methods N = 118 Mp: post + biweekly survey Design: mixed methods	Groups: 1 Teaching format: BL Didactical integration: N/A Digital elements: smart board tools, virtual classrooms, course website, Blackboard (quizzes, students' online feedback, forums, course tools), Google Docs, LMS	Target values: students' attitude and satisfaction Students' evaluation (quantitative, post): 23 questions towards BL elements and tools: team-based learning, online students' writing feedback, f2f lectures, Blackboard, software and digital resources, Google Docs, joining senior faculty research project, assessment; 5-point Likert scale (strongly disagree, disagree, undecided, agree, strongly agree). Evidence Level: B Target value: students' performance Exam: final exam (N/A) Evidence Level: C Target value: students' satisfaction Students' feedback (qualitative, biweekly): self-reported biweekly semi-structured feedback about virtual classrooms, team-based learning and f2f lectures.
Back et al. (2012), Germany [15]	Subject: orthopedics and trauma surgery N = 108 Mp: post Design: quantitative	Groups: 1 Teaching format: BL Didactical integration: media didactic and technical aspects, curriculum integration Digital elements: LMS, Videos, Podcasts, interactive images editing with Blackboard software, virtual patient cases, knowledge tests, 3D animations	Target values: students' acceptance and satisfaction Students' evaluation: 12 self-generated questions on the acceptance and satisfaction of the learning program; 5-point Likert scale (strongly disagree, disagree, neutral, agree, strongly agree). Two open-ended questions about particular like and potential for improvement. Evidence Level: C
Bradley et al. (2023), USA [16]	Subject: medical science structural anatomy course N = 170 Mp: pre + 5 interim surveys + post Design: mixed methods	Groups: 4 active learning groups, one control group; each n = 31–36 Teaching format: online-learning Didactical integration: Jigsaw, Team-Learning Module (adaptation of Team-Based Learning model), Concept Mapping, Question Constructing Digital elements: Canvas Learning Management System, Students recorded PowerPoint slide; discussion board; Canvas quizzes	Target value: students' satisfaction Students' evaluation (quantitative): 5 items: preparedness, usefulness, productiveness, appropriateness, likelihood; 5-point Likert scale in a combined score ranging from 5 to 25 (5 = least satisfied, 25 = most satisfied). The post-course survey asked students to rank all the active learning techniques from best to worst based on preparedness, usefulness, productiveness, appropriateness, and likelihood of using the techniques in the future. Evidence Level: C Target value: course evaluation Students' evaluation (qualitative): one open-ended question: 'Is there anything else you'd like to add?' Analyzed categories (active learning technique helped in the learning process, was time-consuming or was not the students' learning style; enjoyed or didn't enjoy active learning technique).

Table 1. Cont.

Authors (Year), Country [Reference Number]	Subject of Teaching, Population (N = Number of Students), Measurement Points (Mp), Study Design	Groups, Teaching Format, Didactical Integration, Digital Elements	Outcomes
Campillo-Ferrer & Miralles-Martínez (2023), Spain [17]	Subject: social studies course in primary education N = 73 Mp: pre + post Design: quantitative	Groups: 1 Teaching format: local teaching Didactical integration: N/A Digital elements: digital platform, WebQuests	Target value: evaluation of the training program Questionnaire: evaluation of the training program based on gamification and flipped classroom. Three subscales: motivation (9 items), learning acquired through the tools (7 items), promotion of democratic education and active citizenship through the platform (12 items); 5-point Likert scale (1 strongly disagree to 5 strongly agree). Evidence Level: A
Chao et al. (2021), Taiwan [18]	Subject: dance course N = 290 Mp: pre + post Design: mixed methods	Groups: in each case Taiwanese and foreign students: 1. BL (n = 96; 28), 2. FC (n = 68; 21), 3. CG (n = 58; 19) Teaching format: 1./2. BL; 3. local teaching Didactical integration: FC Digital elements: Tron Class teaching platform, Videos	Target value: students' physical activity class satisfaction Questionnaire (quantitative): Physical Activity Class Satisfaction Questionnaire (PACSQ); 32 items for nine factors: teaching, normative success, cognitive development, mastery experiences, fun and enjoyment, improvement of health and fitness, diversionary experiences, relaxation, and interaction with others. 7-point Likert scale (1 strongly disagree to 7 strongly agree). Evidence Level: A Target value: students' dance skills learning effectiveness Practical exam video: the students' performances for the exams were recorded and uploaded for assessing the skills and learning effects Evidence Level: C Target value: students' learning experiences Focus group interviews (qualitative): four questions about original and changed habits, influence on the convenience of learning, difficulties and problem solving

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Authors (Year), Country [Reference Number]	Subject of Teaching, Population (N = Number of Students), Measurement Points (Mp), Study Design	Groups, Teaching Format, Didactical Integration, Digital Elements	Outcomes
Dantas & Kemm (2008), Australia [19]	Subject: science physiology laboratory-based course N = 78 Mp: post Design: mixed methods	Groups: 1 Teaching format: BL Didactical integration: N/A Digital elements: e-learning website; query tools; digital interactive assignments	Target values: quality of teaching, students' usability of the e-learning website, students' use of e-learning, students' learning outcomes Students' evaluation (quantitative): university-wide quality of teaching survey (10 items); usability of the e-learning website (5 items); students' use of and learning outcomes from e-learning (8 items). 5-point Likert scale (5 strongly agree; 4 agree; 3 neither agree nor disagree; 2 disagree; 1 strongly disagree). Open-ended questions (N/A). Exam: final examination Evidence Level: C Target value: students' experience with online learning Interviews (qualitative): questions about students' past experience with online learning, details of students' views on the clarity and navigation of the website, any problems, the learning outcomes that they thought had been achieved by e-learning, and the students' feelings toward the group work in the assignment and the performance of their group.
Dlouha & Burandt (2015), Germany / Czech Republic [20]	Subject: transdisciplinary teaching of sustainability issues in an international teaching program N = 38 Mp: pre + post Design: mixed methods	Groups: 1 Teaching format: BL Didactical integration: N/A Digital elements: Moodle Wiki	Target values: students' learning experience, (online) communication, learning approach Questionnaires (quantitative): Experiences of Teaching and Learning Questionnaire (ETLQ); Revised Approaches to learning and Studying Inventory Questionnaire (RASI); both: 3-point Likert scale (1 strongly disagree; 3 don't agree or disagree; 5 strongly agree). Evidence Level: B Target value: students' competence development Students' evaluation (quantitative): skill description (e.g., computer skills, problem solving skills, work with other students); 12 Items; 3-point Likert scale (1 strongly disagree; 3 don't agree or disagree; 5 strongly agree). Evidence Level: C Target value: students' learning context Qualitative feedback and focus groups: information about the context of the learning process, e.g., prior knowledge of the course topic, detailed feedback on e-learning tools, course content, discussion topics, workload, and satisfaction with own performances.

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Authors (Year), Country [Reference Number]	Subject of Teaching, Population (N = Number of Students), Measurement Points (Mp), Study Design	Groups, Teaching Format, Didactical Integration, Digital Elements	Outcomes
Drozdikova-Zaripova & Sabirova (2020), Russia [21]	Subject: methodology and method of organizing in psychological and pedagogical education N = 65 Mp: pre + post Design: quantitative	Groups: 1. undergraduate students ($n = 30$), 2. baccalaureate ($n = 35$, separate analysis) Teaching format: BL Didactical integration: FC Digital elements: video-lecture, closed group in social network, virtual auditorium; digital tests	Target value: teaching quality Students' evaluation: teaching arrangement level (5 items), qualification and responsiveness of teacher (5 items), content of digital education resource (5 items). 7-point Likert scale (1 completely unsatisfactory, 7 totally satisfactory). Evidence Level: C Target values: students' self-organizing particularities, students' learning motivation Questionnaire: Diagnostic of self-organizing particularities-39 (DSP-3), methodic for diagnostic of students' learning motivation: motives of learning activity (communicative motives; avoiding motives; prestige motives; professional motives; creative self-realization motives; educative-cognitive motive; social motives). Scales N/A Evidence Level: B
Fatima et al. (2017), Pakistan [22]	Subject: neuroscience module in medicine N = 98 Mp: post Design: mixed method	Groups: 1 Intervention: BL Didactical integration: FC Digital elements: video lectures; quiz; Padlet; Kahoot	Target value: students' perceptions of learning experience Questionnaire (quantitative): four factors: students' perception of pre-session instructions/preparation (6 items), perception towards student-teacher interaction (2 items), students' perception towards active learning and engagement (5 items), utility of flipped classroom (4 items). 5-point Likert scale (1 strong negative association, 3 neutral, 5 strong positive association). Evidence Level: A Target value: students' experience of using FC Students' evaluation (qualitative): One open-ended question about the experience of using FC. Analyzed by categories (content delivery; video and reading material; session scheduling; unmotivated students; interaction driven learning; formative assessment for learning).

Table 1. Cont.

Authors (Year), Country [Reference Number]	Subject of Teaching, Population (N = Number of Students), Measurement Points (Mp), Study Design	Groups, Teaching Format, Didactical Integration, Digital Elements	Outcomes
Gazibara et al. (2015), Serbia [23]	Subject: epidemiology in medicine N = 185 Mp: pre + post Design: quantitative	Groups: 1. e-seminar ($n = 36$), 2. CG (classroom, $n = 149$) Teaching format: 1. online-learning, 2. local teaching Didactical integration: N/A Digital elements: practical workbook, Moodle	Target values: students' motives for enrollment (pre), students' satisfaction (post) Students' evaluation: 5 items for several motives for enrollment and 3 items for their initial expectations; 5-point Likert scale (1 = strongly disagree, 5 = strongly agree). 6 items for overall satisfaction and impressions from the course; 5-point Likert scale (1 I strongly disagree to 5 I strongly agree), marks 4–5 were considered as positive attitude for the given statement. Evidence Level: C Target value: students' performance (post) Exam: oral exam accounts for 70% of the total grade and 3% received for the oral presentation of seminar topic. MSCQ: 27% of the total grade consists of points received in the written quiz in mid-semester. Evidence Level: C
Graf & Yaman (2011), Germany/Turkey [24]	Subject: biology education N = 99 Mp: pre + post Design: quantitative	Groups: 1 Teaching format: BL Didactical integration: N/A Digital elements: e-learning platform; cooperative task processing, communication in the teams and with the instructors; online materials, videos	Target values: online materials, students' satisfaction, online communication, communication and group activities, overall concept Students' evaluation: evaluation of online materials: usefulness (3 items; 5 very useful to 1 not useful at all) and technical issues (3 items; 5 completely agree to 1 strongly disagree). Satisfaction with various activities (6 items). Evaluation of online communication tools (7 items for usefulness, learning effects and success), communication and group activities (12 items), and of the overall concept (8 items). 5-point Likert scale (N/A). Evidence Level: B

Table 1. Cont.

Authors (Year), Country [Reference Number]	Subject of Teaching, Population (N = Number of Students), Measurement Points (Mp), Study Design	Groups, Teaching Format, Didactical Integration, Digital Elements	Outcomes
Liu et al. (2022), China [25]	Subject: physiology course in clinical medicine N = 1576 Mp: pre + post Design: quantitative	Groups: 1. HBOPPPS model, year 2018 (<i>n</i> = 526) and year 2019 (<i>n</i> = 518), 2. control group, BOPPPS model, year 2017 (<i>n</i> = 532) Teaching format: BL Didactical integration: HBOPPPS (hybrid development of BOPPPS: Bridge-in, Objective/Outcomes, Pre-assessment, Participatory learning, Post-assessment, Summary) Digital elements: Mobile App (Xuexi Tong): micro-lecture videos, single/multiple-choice questions, science stories and clinical cases; posting questions, private chat with teachers, discussions, notes, mind maps	Target value: students' initiatives of self-learning Mobile App Score: automatically generated by the system of the mobile app; micro-lecture video watching (30 points), homework for each chapter (40 points), test (10 points), attendance (20 points). Max. 100 points. Evidence Level: C Target value: students' performance Final examination: final examination of the physiology course was worthy of 100 points, consisting of 50 MSCQ (1 point/question) and 50 points of subjective questions, i.e., 6 short (5 points each) and 2 long (10 points each) essays. Max. 100 points. Evidence Level: C Target values: students' learning ability, students' satisfaction, advantages, disadvantages, teaching methods Students' evaluation: overall 6 items: Do you like Physiology? Are you satisfied with the Physiology course? 4-point Likert scale (very much, like, fair, no). Does the online course improve your learning ability? 4-point Likert scale (strongly improved, improved, fair, no change). What do you think are the advantages of the Physiology course? 4 and 7 multiple-choice answer options. What do you think are the disadvantages of the Physiology course? Which method of teaching modality do you prefer? 3 answer options (online teaching, offline teaching, hybrid teaching). Evidence Level: C

Table 1. Cont.

Authors (Year), Country [Reference Number]	Subject of Teaching, Population (N = Number of Students), Measurement Points (Mp), Study Design	Groups, Teaching Format, Didactical Integration, Digital Elements	Outcomes
Lu et al. (2023), China [26]	Subject: physiology course in clinical medicine N = 131 Mp: post Design: quantitative	Groups: 1. FC (n = 62), 2. traditional teaching (n = 69) Teaching format: BL Didactical integration: FC Digital elements: Chaoxing Group and Xueyin Online (platforms); micro videos, virtual simulation experiment teaching videos, sets of chapter test questions	Target value: students' performance Online Platform Score: automatically collected by "Xueyin Online" platform, according to students' performance in video watching (20 points), discussion (10 points), homework (20 points), quizzes (20 points), attendance (10 points), and classroom activities (20 points). Accounting for 40% of the final grades. Final exam: single-choice questions, multiple-choices questions, short answer questions, and essay questions, with a total of 100 points, accounting for 60% of the final grades. A score of 90–100 points is excellent, 80–89 points is good, 70–79 points is average, 60–69 points is fair, and lower than 60 points is failure. Evidence Level: C Target values: students' knowledge acquisition, students' learning ability, potential contributors of FC teaching in promoting learning effectiveness in physiology, advantages of FC teaching Students' evaluation (only FC group): overall four items: students' knowledge acquisition (strongly improved, improved, fair, no change). Learning ability (multiple-choice scale: self-study ability, cooperation ability, ability to analyze and solve problems, communication and presentation skills, clinical thinking). Potential contributors of FC teaching in promoting learning effectiveness in physiology, multiple-choice scale (group collaborative learning, diverse teaching methods, rich teaching resources, active classroom environment, timely answering questions). Advantages of FC teaching, multiple-choice scale (teaching design and teaching environment, teaching arrangement, level of students' engagement, presentation of group learning, classroom quiz). Evidence Level: C
Ma & Lee (2021), China [27]	Subject: statistics course N = 133 Mp: post Design: mixed methods	Groups: 1. BL (n = 37), 2. e-learning (n = 45), 3. CG (face-to-face seminar, n = 51) Teaching format: 1. BL 2. e-learning, 3. local teaching Didactical integration: ARCS model (Keller, 1999) Digital elements: online videos, instructional videos	Target value: students' learning effectiveness (attention, relevance, confidence, satisfaction) Questionnaire (quantitative): four factors: attention (4 items), relevance (3 items), confidence (3 items), satisfaction (8 items). 5-point Likert scale (1 strongly disagree to 5 strongly agree). Evidence Level: A Target value: students' perception on attention, relevance, confidence, and satisfaction Group interview (qualitative): four group interviews in the BL and e-learning group.

Table 1. Cont.

Authors (Year), Country [Reference Number]	Subject of Teaching, Population (N = Number of Students), Measurement Points (Mp), Study Design	Groups, Teaching Format, Didactical Integration, Digital Elements	Outcomes
Melton et al. (2009), USA [28]	Subject: health course N = 251 Mp: pre + post Design: quantitative	Groups: 1. BL seminar (n = 98), 2. CG (traditional, n = 153) Teaching format: 1. BL, 2. local teaching Didactical integration: N/A Digital elements: PowerPoint, quizzes, WebCT Vista course management system	Target value: students' course achievement (pre, post) MSCQ: 50 multiple-choice questions to assess course content of the course materials. Exam: four written exams for the final course grade (midterm, post) Evidence Level: C Target values: educational quality, students' satisfaction, teacher/course evaluation (post) Questionnaire: modified Students' Evaluation of Educational Quality (SEEQ). 15 items, 5-point Likert scale (5 strongly agree, 4 agree, 3 neutral, 2 disagree, 1 strongly disagree). Points are summed up: 51–60 highly satisfied, 41–50 moderately satisfied, 31–40 satisfied, 21–30 dissatisfied, 11–20 moderately dissatisfied, 1–10 highly dissatisfied. Students' evaluation: university-wide teacher and course evaluation, 14 items, e.g., organization, instructors' helpfulness, course materials. 5-point Likert scale (5 very good, 4 good, 3 satisfactory, 2 poor, 1 very poor). Evidence Level: B

Table 1. Cont.

Authors (Year), Country [Reference Number]	Subject of Teaching, Population (N = Number of Students), Measurement Points (Mp), Study Design	Groups, Teaching Format, Didactical Integration, Digital Elements	Outcomes
Ornellas & Muñoz Carril (2014), Spain [29]	Subject: use and application of ICT in the academic and professional environments N = 82 Mp: post Design: mixed methods	Groups: 1 Teaching format: e-learning Didactical integration: N/A Digital elements: social bookmarking, remote collaboration tools, e-calendars, blog, video platform, video channels, various ICT tools; audio-visual projects	Target values: students' satisfaction, level of skills acquired, teaching performance, teaching and learning resources and tools, evaluation of continuous assessment practices Students' evaluation (quantitative): university-wide course evaluation with four dimensions: overall satisfaction, teaching performance, teaching and learning resources, system of assessment. Scale (N/A). Additional self-generated questions about the level of skills acquired (8 items), the resources and tools and how to use them, the continuous assessment practices (4 assessment practices with 5 items). 3-point Likert scale (low, medium, high). Evidence Level: C Target values: teaching performance, strengths and weaknesses of the course Students' evaluation (qualitative): Two open-ended questions: 'Did the teacher facilitate your learning in the subject?' and 'Did the evaluation and feedback by the teacher during the continuous assessment help you to carry out the final project?'. Analyzed by categories (teachers' speed of response to their doubts and queries, guidance and clarifications given in the assessment activities, monitoring of work carried out, clarity and usefulness of the teachers' guidance. One open question for assessing the strengths of the course (collaborative work, personalized attention by the teacher) and weaknesses of the course (workload, technical problems with some of the tools used).
Ouchaouka et al. (2021), Morocco [30]	Subject: cell biology in life and earth sciences N = 292 Mp: post Design: quantitative	Groups: 1 Teaching format: BL Didactical integration: individual progress through the serious game Digital elements: serious game, Moodle, quizzes, Unity 3D software, LMS	Target values: students' relevance and attractiveness Students' evaluation: six factors: academic information (8 items), 8-point Likert scale (N/A). Teaching context (3 items), learning barriers (3 items), digital learning environments (3 items), 3-point Likert scale (N/A). Communication modalities (4 items), pedagogical innovation and integration of ICT (5 items), 4-point Likert scale (N/A). Evidence Level: B

Table 1. Cont.

Authors (Year), Country [Reference Number]	Subject of Teaching, Population (N = Number of Students), Measurement Points (Mp), Study Design	Groups, Teaching Format, Didactical Integration, Digital Elements	Outcomes
Pieter et al. (2004), Germany [31]	Subject: education sciences N = 23 Mp: pre + post Design: mixed methods	Groups: 1 Teaching format: BL Didactical integration: instructional design (Gagne et al., 2004), ARCS model (Keller, 1999), basic principles according to Bourdeau & Bates (1997) Digital elements: video-, audio-, and text-based learning units (online versions or CD-ROM)	Target values: students’ usage behavior (pre), product-oriented criteria, process-oriented criteria, Internet interest and EDP knowledge, control and visual design, quality of technical implementation, importance of individual program aspects, acceptance (post) Students’ evaluation (quantitative): frequency of use of various Internet services (6 items), scale (1 I don’t know; 2 never; 3 rarely; 4 sometimes; 5 often; 6 very often). Product-oriented criteria (motivation, curriculum, usability, design), process-oriented criteria (study program integration, transferability, quality assurance, didactical aspect). Scale (grades 1 very good to 6 unsatisfactory). EDP knowledge and interest of the students (2 items; very good; rather good; average; rather bad; very bad), simplicity of control and clarity of appearance (2 items), assessment of individual components (5 items), scale (very good; good; average; poor; very poor; not specified). Importance of individual program aspects (5 items; very important; important; unimportant; not specified), agreement with individual statements (10 items; fully agree; rather agree; don’t know; rather disagree; completely disagree; not specified). Evidence Level: C Target values: students’ motivation to participate, benefits, interests, times of course processing Students’ evaluation (qualitative): five open-ended questions about motivation and benefits to participate, interests of online learning, time of course processing and particular likes.

Table 1. Cont.

Authors (Year), Country [Reference Number]	Subject of Teaching, Population (N = Number of Students), Measurement Points (Mp), Study Design	Groups, Teaching Format, Didactical Integration, Digital Elements	Outcomes
Surov et al. (2021), Germany [32]	Subject: imaging techniques in human medicine N = 110 Mp: post Design: mixed methods	Groups: 1 Teaching format: e-learning Didactical integration: N/A Digital elements: videos; video presentations; Zoom (online seminar, chat function, monitor sharing)	Target value: course evaluation (time effort, retrievability of video presentations, design of video conferences, general structure of the digital teaching concept) Students' evaluation (quantitative): 11 self-generated questions: time required, video length, video duration, profit from teaching concept, retention of teaching concept, retrievability of the videos, design of video conferences, knowledge transfer, interest, animation for self-study, flexible learning, general structure of the digital teaching concept; 5-point Likert scale (fully agree; agree; undecided; disagree; disagree at all). Optimal duration of a video segment; 5-point Likert scale (<10 min, 10–20 min, 21–40 min, 41–60 min, >60 min). Evidence Level: C Target value: course evaluation Students' evaluation (qualitative): One open-ended question for comments. Analyzed by categories (good implementation of teaching, positive assessment of the new teaching concept or the video presentations provided, retention or increased use of assignments or case studies to prepare for the online seminars).
Wilson & Greig (2017), Scotland, UK [33]	Subject: sports therapy N = 164 Mp: post Design: qualitative	Groups: level of difficulty in the online channel: level four (n = 67), level five (n = 51), level six (n = 46) Teaching format: BL Didactical integration: N/A Digital elements: instructional videos; Blackboard virtual learning environment	Target value: students' experience Students' evaluation (qualitative): seven open-ended questions to investigate students' experience of an online video-based learning channel across modules in levels four, five, and six.
Wong et al. (2004), China [34]	Subject: health education for prosthetics and orthotics N = 1613 Mp: post Design: quantitative	Groups: 1. e-learning (n = 20), 2. CG (standard curricula, n = 61), 3. CG (entire university, n = 1532) Teaching format: 1. e-learning, 2. N/A, 3. N/A Didactical integration: N/A Digital elements: multimedia components (video, PPP, text); WebCT (forum); slide shows, handouts, tutorials, electronic exercises, assignments, quizzes; online discussion forum	Target values: students' career relevance, learning outcomes, critical thinking, creative thinking, ability to pursue lifelong learning, communication skills, interpersonal skills, problem solving, adaptability, workload (reversed) Students' evaluation: 10 factors (same as target values). 5-point Likert scale (strongly disagree to strongly agree). Evidence Level: C

Table 1. Cont.

Authors (Year), Country [Reference Number]	Subject of Teaching, Population (N = Number of Students), Measurement Points (Mp), Study Design	Groups, Teaching Format, Didactical Integration, Digital Elements	Outcomes
Zarcone & Saverino (2022), Italy [35]	Subject: human anatomy in medicine N = 444 Mp: post Design: quantitative	Groups: 1. e-learning ($n = 236$), 2. CG (f2f teaching, $n = 208$) Teaching format: 1. e-learning, 2. local teaching Didactical integration: N/A Digital elements: PowerPoint; Microsoft Teams; audiovisuals (interaction on slides; chat features); Visible Body 3D models; EdiErme dissection clips	Target value: students' perceived quality of the didactics Students' evaluation: 12 questions: clarity of presentation, availability of the teacher for further explanations, need for basic preliminary knowledge, perceived learning weight. 4-point Likert scale (4 strongly agree, 3 somewhat agree, 2 somewhat disagree, and 1 strongly disagree). Answers were grouped into "negative score" and "positive score". Evidence Level: B Target value: students' performance Exam: final examination: microscopic recognition of an anatomical structure, oral examination on topographical and visceral anatomy topic. Evidence Level: C
Legend: N/A = not available, Mp = measurement points; teaching format: (BL) = blended learning approach; didactical integration: (FC) = flipped classroom approach, (ARCS) = attention, relevance, confidence, satisfaction, (HBOPPS) = Hybrid, Bridge-in, Objectives and Outcomes of Learning, Pre-assessment, Participatory learning, Post-assessment, Summary. Groups: (CG) = control group; digital elements: (LMS) = learning management system, (MSCQ) = multiple- and single-choice questions, (ICT) = information and communication technology.			

A total of 22 studies were analyzed, involving 6141 students (Min: $n = 23$; Max: $n = 1613$; $M = 279$; $SD = 427$) enrolled in bachelor's or master's degree programs. The studies, published between 2004 and 2023, were conducted in various countries. The following countries were included in the studies: Australia (1), China (4), Czech Republic (1), Germany (5), Italy (1), Morocco (1), Pakistan (1), Russia (1), Saudi Arabia (1), Scotland, UK (1), Serbia (1), Spain (2), Taiwan (1), and Turkey (1). Additionally, two studies were conducted in two different countries [20,24]. The studies covered a broad range of subjects, including anatomy (2), biology (2), dance (1), education science (2), epidemiology (1), health science (3), imaging techniques (1), neuroscience (1), orthopedics (1), physiology (3), psychology (1), sports therapy (1), and statistics (1).

The research corpus includes a variety of study designs, measurement methods, didactic integrations, comparative analyses, and instructional delivery formats (see Table 2).

Table 2. Summary of the results in the relevant categories and subcategories, including study designs, measurement methods, didactic integration, comparative analyses, and instructional delivery formats, with the corresponding references.

Category	Subcategory	Number of Studies [n]	References
Study design	Post-intervention measurements	12	[14,15,19,22,26,27,29,30,32–35]
	Pre-post design	9	[17,18,20,21,23–25,28,31]
	Interim assessments	2	[14,16]
Measurement methods	Quantitative surveys	11	[15,17,21,23–26,28,30,34,35]
	Qualitative surveys	1	[33]
	Combined quantitative and qualitative surveys	10	[14,16,18–20,22,27,29,31,32]
Didactic integration	Flipped/inverted classroom	4	[18,21,22,26]
	Didactic theories (e.g., ARCS model)	2	[27,31]
	Instructional design principles	1	[31]
	HBOPPPS model	1	[25]
	WebQuest method	1	[17]
	Other didactic aspects	4	[15,16,30,31]
Comparative analyses	E-teaching vs. traditional methods	5	[23,25,26,28,35]
	University students vs. high school graduates	1	[21]
	Two e-teaching formats vs. control group	3	[18,27,34]
	Comparison of difficulty levels in serious games	1	[33]
	Active learning groups vs. control group	1	[16]
Instructional delivery format	Blended learning (BL)	15	[14,15,18–22,24–28,30,31,33]
	E-learning	7	[16,23,27,29,32,34,35]
	Traditional face-to-face (local teaching)	6	[17,18,23,27,28,35]

The instructional methods employed a diverse range of digital elements, including various technologies and formats. Videos were the most frequently utilized digital resource, featured in sixteen studies. Learning platforms were employed in thirteen studies, while smartboard tools and interactive documents were used in ten studies. Eight studies integrated learning management systems, highlighting their importance in delivering educational content. Six studies utilized quiz formats and seven utilized query tools, facilitating interactive learning and assessment. Five studies incorporated discussion forums and e-lectures, providing platforms for synchronous and asynchronous communication and learning. Three studies mentioned the use of three-dimensional (3D) animations and PowerPoint presentations to enhance visual learning and presentation. Two studies noted the use of meeting tools and virtual patient cases to support remote interaction and applied learning. The educational landscape is enriched by a wide array of digital elements, includ-

ing game-based learning and podcasts, as highlighted in one study and other miscellaneous elements cited in four studies.

To answer the research question, authors classified the target values into five categories: students' performance, psychological outcomes, utilization of digital elements, teaching quality, and course evaluation. These categories are listed in descending order based on the prevalence of the target values within each category, as explained below.

3.1. Quantitative Methods

3.1.1. Evidence Level (A)

Within evidence level (A), seven target values have been identified: students' attention, relevance, confidence, satisfaction in the category psychological outcomes, and perceptions of the learning experience and evaluations of the training program in the category course evaluation. To measure these outcomes, four studies employed existing questionnaires such as the Patient Assessment of Care and Satisfaction Questionnaire (PACSQ) and the Attitudes to Randomized Controlled Trials Questionnaire (ARCS) [17,18,22,27].

3.1.2. Evidence Level (B)

Under evidence level (B), eight outcomes have been categorized as psychological outcomes, including target values such as students' satisfaction, acceptance, learning motivation, and attitude. Additionally, three outcomes relevant to course evaluation were identified, including students' learning experience, communication, and engagement in group activities. In addition, two objectives were summarized under the categories of students' utilization of digital elements and teaching quality. To assess these values, established questionnaires such as the ETLQ, RASI, and SEEQ were used in three studies [20,21,28]. In contrast, four studies used self-developed questionnaires to capture specific values [14,24,30,35]. Additionally, one study utilized a university-wide survey to collect data [28].

3.1.3. Evidence Level (C)

The studies were mostly categorized as evidence level (C), with students' performance being the most frequently reported target values (23 instances). These values were characterized by learning outcomes, skills development, or examination performance. A compilation of 12 objectives was categorized under the utilization of digital elements, including target values such as students' usability, usage behavior, design of digital tools, or technical implementation. Within the course evaluation category, 14 target values were identified. These outcomes encompass assessments of course content, teaching quality, knowledge transfer, benefits derived from the teaching concept, or its general structure. Additionally, eight target values were outlined under psychological outcomes, highlighting aspects like students' acceptance or satisfaction. The different methods for quantitative evaluation within the studies included can be found in Table 3.

Table 3. Summary of the evaluation methods used in the studies included, highlighting the diversity of approaches and the corresponding references in evidence level C.

Evaluation Method	Number of Studies [n]	References
Self-generated questionnaires	10	[15,16,20,21,23,25,26,31,32,34]
Written and oral examinations	6	[14,23,25,26,28,35]
Practical examination videos	1	[18]
Multiple-choice questionnaires	2	[23,28]
University-wide surveys	2	[19,29]
Quantitative measurement of engagement/proficiency scores	2	[25,26]

3.2. Qualitative Methods

Qualitative methods were used to identify eleven target values, such as teaching performance, students’ experiences, and the course’s strengths and weaknesses, to elucidate the course evaluation category. Additionally, seven target values were used to delineate psychological outcomes, including students’ satisfaction, interests, or motivation to participate. The different methods for qualitative evaluation within the studies included can be found in Table 4.

Table 4. Summary of the qualitative evaluation methods used in the studies included, providing an overview of the approaches and the corresponding references.

Evaluation Method	Number of Studies [n]	References
Open-ended questions in questionnaires	6	[16,22,29,31–33]
Focus groups and interviews	4	[18–20,27]
Semi-structured feedback via Blackboard method	1	[14]

Further details regarding the aspects displayed here and the single references can be found in the Supplementary Materials.

4. Discussion

The objective of this systematic review was to synthesize and critically analyze the methods and target values used in the assessment of teaching concepts, with particular emphasis on the incorporation of digital elements in higher education. These were grouped into five distinct categories: students’ performance, psychological outcomes, utilization of digital elements, teaching quality, and course evaluation.

Within the studies included in this review with the highest level of evidence (level A), characterized by the use of questionnaires supported by validated references and quality criteria, the derived target values were predominantly categorized as psychological outcomes and course evaluations. This classification applied to only 4 of the 22 studies reviewed [17,18,22,27], highlighting a notable lack of research employing evidence-based methods in the studies of teaching concepts augmented with digital elements. Conversely, at level B evidence, an ensemble of seven studies was reviewed, expanding the analytical focus to include psychological outcomes, course evaluation, students’ utilization of digital elements, and teaching quality. The methods used for data collection in the studies analyzed in this review fell predominantly into two categories: those that adhered to established quality criteria, exemplified by the ETLQ, RASI, and SEEQ [20,21,28], and those that were developed by the researchers themselves using scientific references for validation. A notable finding from the analysis was that a significant majority of the target values in 16 of the 22 studies reviewed were classified as level of evidence C. This level encompasses a wide range of dimensions, including students’ performances, utilization of digital elements, course evaluation, or psychological outcomes. The methods used in these cases varied, ranging from self-administered questionnaires to exam performance assessments to university-wide surveys.

Qualitative research methods were used to examine psychological outcomes and course evaluations in eleven of the analyzed studies. Data collection techniques included open-ended questionnaires, focus group discussions, individual interviews, and the collection of student feedback through interactive platforms such as Blackboard. This shows a trend towards the integration of qualitative methods as a complement to quantitative approaches in educational research. Notably, only one study [33] employed exclusively qualitative methods, utilizing open-ended questions to gain insight into students’ experiences. The practice of using self-constructed evaluations provides lecturers and universities with the flexibility to tailor questions specifically to the context of their students. How-

ever, this approach presents a challenge in terms of standardization, making it difficult to compare course evaluation results across educational settings or institutions.

This literature review shows that the target value categories discussed in this paper are common in a significant body of research. An extensive review of 619 studies conducted between 2009 and 2018 highlights the evolving landscape of online learning and teaching [36]. The most prevalent research themes are 'learner engagement' and 'learner characteristics', accounting for 29% and 22% of the studies, respectively. 'Learner engagement' refers to a variety of concepts, such as presence, interaction, community participation, collaboration, involvement, and communication. On the other hand, 'learner characteristics' are expressed through dimensions such as self-regulation, motivation, and academic and affective attributes. Research themes that received less attention include 'learner outcomes', 'instructor characteristics', 'institutional support', 'course technologies', and 'evaluation and quality assurance', each varying in frequency from 3% to 6%. Notably, the investigations related to 'course technologies' explore the use of digital elements in online learning environments, such as wikis, former Twitter (now X), WebCT, screencasts, and web conferencing systems. The theme of 'evaluation and quality assurance' is characterized by studies that assess courses and programs, evaluate online learning systems, and apply quality standards such as quality matters to assess educational quality.

Recent studies show that digital elements and teaching formats have a significant impact on higher education. Factors such as adaptability, interactivity, and self-efficacy with digital components (such as computers and the Internet) shape students' engagement in these settings [37]. Furthermore, a comprehensive meta-analysis highlights the effectiveness of the flipped classroom teaching format in different academic fields, demonstrating significant improvements in students' attitudes, students' engagement, students' performance, and a range of other learning outcomes [38]. Based on these findings, it is important for evaluations in higher education to include these key values in course evaluations.

Schoenbaechler [39] prompts an examination of the current academic landscape in the scholarly discourse concerning the adaptation of course evaluations to encompass digital elements and teaching formats. A stratified evidence base is revealed within the scope of this systematic review, based on students' utilization of digital elements. Studies classified under evidence level A did not delineate any target values related to digital utilization. Conversely, evidence level B includes a single study [24] that identified two target values. In contrast, five studies [19,29,31,32,34] identified a broader range of twelve target values, which were categorized under evidence level C. They cover various dimensions, such as digital element usage behavior, perceived utility of digital elements, assessments of communication technologies, and technical execution of digital elements in educational settings.

This systematic review categorizes target values across evidence levels, providing a nuanced examination of the adoption of quantitative methods in the domain of digital element utilization in educational settings. It is noteworthy that the deployment of such methods appears to have minimal grounding in established references or quality criteria. The validation study conducted on the 'Modular Questionnaire for the Evaluation of Digital Teaching-Learning Scenarios' (MOFEDILLS) highlights the potential for an evidence-based approach to course evaluation that comprehensively incorporates digital elements and teaching formats [40]. The framework proposes querying students on key modules, such as prerequisites for success or learning and performance outcomes, to enable a comprehensive assessment of digital integration in educational contexts.

However, there is a noticeable gap in the literature, as empirical investigations using the MOFEDILLS instrument to evaluate university teaching are lacking. Furthermore, there is a variant of the questionnaire designed for lecturer feedback, but its validity has not been substantiated through rigorous testing. The modular components of MOFEDILLS enable a comprehensive examination of different aspects of digital education. These include experiences with digitally supported teaching methods, engagement with digital

resources, evaluation of digital competencies, attitudes towards digital transformation, and the structural conditions of various teaching modalities or didactic strategies.

Strengths and Limitations

This review was not registered online while it was in the planning stage. This of course increases the probability of an unplanned duplication and does not allow a verification that review methods were carried out as planned.

One limitation of this systematic review is the heterogeneity of study designs included due to the scarcity of randomized controlled trials (RCTs) in this specific research area. To address this diversity, the studies were stratified in our analyses into evidence levels (A to C) based on the quantitative research methods used. The field of artificial intelligence (AI) has advanced significantly and has been increasingly integrated into university teaching practices and concepts, particularly since the launch of ChatGPT in November 2022 [41,42]. The use of AI in academic settings and in higher education is gaining attention. It is important to examine the implications and effectiveness of AI deployment in higher education. Future research should focus on this topic.

This review's methodological rigor is a notable strength. The authors conducted an exhaustive search across five databases, each study carefully selected for its thematic relevance. Additionally, two independent reviewers, blinded to each other's assessments, employed the PICO scheme to assess and include studies [10]. This systematic review aims to provide an initial summary of evidence in the field of sports science. Sports science is a discipline that combines lectures, seminars, practical exercises, and sports practice sessions. This diverse educational landscape offers various opportunities for the integration of digital elements, highlighting the specificity and complexity of the sports science domain.

5. Conclusions

This analysis presents a systematic classification of target values in educational research using both quantitative and qualitative methods. The delineation into evidence levels (A), (B), and (C) facilitates a structured appraisal of quantitative evaluation techniques. The analysis showed that self-developed questionnaires and performance examination were the most commonly used methods, falling under evidence level C. Only a few studies met the criteria for evidence level A, which focused on psychological outcomes and course evaluations in the context of teaching concepts integrated with digital elements. Open-ended questions in questionnaires, interviews, and feedback mechanisms provide valuable insights into students' experiences and perceptions, playing a crucial role in refining teaching concepts.

The results suggest that a comprehensive understanding of teaching and learning processes requires the integration of both quantitative and qualitative methods in course evaluations. Future adaptations of course evaluation in universities, particularly regarding the integration of digital elements in teaching, would benefit from the development and rigorous testing of evidence-based measurement techniques. The use of artificial intelligence (AI) in higher education teaching is rapidly evolving and is a critical factor to consider.

Supplementary Materials: The following supporting information can be downloaded at: <https://www.mdpi.com/article/10.3390/higheredu3030042/s1>. Search syntaxes for databases, categories for target values and methods, and details of sample description, measurement points, study design, fields of study, groups, teaching format, and digital elements.

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