



The extent and quality of evidence for osteopathic education: A scoping review

Andrew MacMillan^{a,b,*}, Patrick Gauthier^a, Luciane Alberto^a, Arabella Gaunt^a, Rachel Ives^a, Chris Williams^a, Dr Jerry Draper-Rodi^{a,c}

^a University College of Osteopathy, 275 Borough High Street, London, SE1 1JE, UK

^b School of Education and Sociology, University of Portsmouth, 2.18d St George's Building, 141 High Street, Portsmouth, PO1 2HY, UK

^c National Council for Osteopathic Research, 275 Borough High Street, London, SE1 1JE, UK

ARTICLE INFO

Keywords:

Knowledge synthesis
Literature review
Education
Osteopathy
Musculoskeletal manipulations

ABSTRACT

Objectives: Standards of osteopathic training and regulation differ by geographical location, and little is known regarding the evidence base for education within osteopathy. This review is the first to chart and appraise the osteopathic pedagogical literature and presents recommendations for further research and practice.

Methods: A scoping review was conducted using the Arksey and O'Malley framework. A search was conducted of EBSCO, OVID (Embase, Medline), CINAHL, Psycinfo, Open Grey, ProQuest and ERIC databases, to identify research related to osteopathic education. Review, selection, data extraction, characterization and Risk of Bias was performed by two independent reviewers and results were summarised using Critical Interpretive Synthesis.

Results: The search identified 66 research papers published from 2002 to 2022. The included papers varied in terms of purpose, methodology, and detail of reporting. The returns were grouped into five categories Teaching, Assessment, Clinical education and preparedness for practice, Curriculum and Miscellaneous. The evidence is generally of robust methodological quality, with bias rated as 29 Low, 26 Moderate, and 11 High. However, most of the methodological designs would traditionally be considered low on the hierarchy of evidence, with 19 commentary articles and the only Randomised Controlled Trial being rated High risk of bias.

Conclusions: The evidence regarding what is taught is underdeveloped and enhancing consensus regarding benchmarking of osteopathic education and minimum competencies is needed. Active learning was an area highlighted as preferred by learners as was self-directed study. This may also integrate more practical learning aids and electronic or online learning.

Implications for practice

This is the first review conducted on the topic of osteopathic education; we charted and appraised the extent and quality of the literature to guide future research priorities. The evidence base for osteopathic education is underdeveloped and mostly consists of low-level evidence such as commentary articles and surveys. This review highlighted a lack of congruency between academic and clinical delivery students' preferences for self-directed and active learning. Future research should be of higher methodological quality and focus on standards of assessment and competency within undergraduate education.

1. Introduction

Osteopathic practice, training and regulation differ globally, regulatory frameworks range from statutory regulation to voluntary registers [1,2]. Typically, osteopathic education takes place in a further or higher educational setting such as a university or private institution. Historically, in the United Kingdom, osteopathy has been taught in small monotechnic institutions, usually by osteopaths and informed by wider pedagogical conventions in further and higher education [3]. It is now informed by a range of standards and benchmarks, set by the regulator and other stakeholder institutions [1,2,4]. We define osteopathic education as, undergraduate and post graduate training delivered to osteopaths or osteopathic students in an accredited educational institution [107]. Education, teaching and learning may take place in many

* Corresponding author. University College of Osteopathy, 275 Borough High Street, London, SE1 1JE, UK.

E-mail addresses: Andrew.macmillan@uco.ac.uk (A. MacMillan), arabella.gaunt@uco.ac.uk (A. Gaunt).

<https://doi.org/10.1016/j.ijosm.2023.100663>

Received 12 August 2022; Received in revised form 8 February 2023; Accepted 7 March 2023

Available online 28 March 2023

1746-0689/© 2023 The Authors. Published by Elsevier Ltd. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

settings, including experiential learning in practice, as self-directed study and informal peer to peer learning or non-accredited continuing education courses and seminars. However, these valuable activities are not the focus of this review.

Osteopathic education has undergone a process of professionalisation with many educators holding advanced degrees and teaching qualifications [3]. The ways in which this professionalisation process has informed osteopathic educational delivery are not fully known, as the extent and quality of the evidence regarding osteopathic education has not been previously reviewed.

Evidence Based Practice (EBP) is “Educational, therapeutic, or other methods integrating rigorous research and clinical expertise that lead to improvements in student performance, patient care, or other services” [108]. Therefore, EBP should inform policy, reducing the waste of scarce resources on ineffective methods of delivery or practice, which may negatively impact learners, educators and other stakeholders [109]. EBP should improve outcomes via informed policy, higher-quality decisions and more effective practices. As practices based on evidence replace those grounded in custom or ideology better results follow [110].

However, implementation of evidence based teaching is not unproblematic, as often policy makers and leaders lack understanding of research and its application. Bridging the gap between research and practice in education is challenging, as it is in clinical settings. In clinical practice, osteopaths are generally supportive of EBP, have moderate-level skills in EBP but engaged in EBP activities infrequently [113]. There are mixed views towards evidence-based practice within osteopathy [111]; the osteopathic profession is becoming more positive about evidence-based practice, yet in 2020 only 50% of surveyed osteopaths agreed or strongly agreed that ‘practising evidence-based osteopathy improves patient care’, compared with 38% in 2014’ [112]. Evidence from a UK cross sectional survey of osteopaths indicates that there are a number of barriers for osteopaths to engage in and utilise research for their practice; such as a lack of time and difficulty interpreting complex information [113].

These challenges are not unique to osteopathy; medical, nursing and allied health professions face similar questions but may be underpinned by a more expansive pedagogical foundation. Which includes, but is not limited to, higher levels of evidence in the form of systematic [114–116] and umbrella reviews [117,118] available for educators to draw upon. The evidence regarding education, beyond the osteopathic literature, is undoubtedly a useful source for osteopathic educators. However, osteopathy is taught, and accredited, as a distinctive programme of education, therefore the evidence regarding education practices and nature and extent of research activity within osteopathy is an important area of inquiry. The extent and quality of current evidence regarding osteopathic education is unknown, and a preliminary search revealed that no previous scoping or systematic reviews are available, and no protocol registrations were returned. Therefore, a scoping review to systematically chart and appraise the available evidence, to assist in decision making regarding educational practice and research priorities was warranted.

2. Methods

The protocol for this study was drafted using the Preferred Reporting Items for Systematic Reviews and Meta-analysis Protocols, Scoping Reviews extension (PRISMA-ScR) [5]. The review protocol was prospectively registered online with the Open Science Framework and submitted for peer review in The International Journal of Osteopathic Medicine (IJOM) [107]. Deviations from the prospective registration and the justification thereof, are detailed in the limitations section of this manuscript. This systematic scoping review followed the 5-step framework as described below [6], previously used in an osteopathic educational context [7]. The stages are described below.

Stage 1. Identifying the research question

The research questions were.

- 1) What is the extent and nature of the existing evidence regarding osteopathic education?
- 2) Are there any elements of the literature which demonstrate good practice that can be adopted in wider osteopathic educational practice?
- 3) Are there any gaps within the evidence base which subsequent research can explore?

Stage 2. Identifying relevant studies

The search strategy was piloted using the OVID (Medline) database. The pilot search was not limited by date or to any type or level of evidence. The Population-Concept-Context (PCC) framework was utilised for this scoping review [8].

The search strategy was discussed with an experienced educational research librarian to minimise the risk of excluding articles that could have been indexed incorrectly on electronic databases. No limitations were placed upon date or language of publication.

The full search was performed on the online databases EBSCO, OVID (Embase, Medline), CINAHL, PsycINFO, Open Grey, ProQuest and ERIC which were searched systematically. Additional hand searches were performed using the International Journal of Osteopathic Medicine, Journal of Osteopathic Medicine, Chiropractic and Manual Therapies and The Journal of Bodywork and Movement Therapy. The reference lists of included results were also screened for eligibility to expand the search. Experienced manual therapy educational researchers were consulted and asked if they were aware of any unpublished works or works in development. Trial and review registries were also searched. The final search involved truncated search terms [9] regarding osteopathy and Education. An example search string for the OVID Medline database is available in appendix 1.

Stage 3. Study selection

Covidence (2.0: V2876) was used to remove duplicates. Titles and abstracts were screened independently, by two of; AMac, JDR, LA, PG, RI, AG, CW and studies not meeting the inclusion criteria (Table 1) were removed. Disagreements were resolved by discussion and the mediation of a third reviewer.

Stage 4. Charting the data

Data were extracted using a template based on our PCC, [107] with inclusion and exclusion criteria, and detailing each included papers’ methodology, setting and key findings. The data extraction tool was piloted by AMac and PG on two included papers and good agreement on extracted items was reached and verified using Krippendorff’s Alpha (a 0.845) [10]. This process ensured consistency between the researchers,

Table 1

Shows the inclusion and exclusion criteria.

Inclusion	Exclusion
Undergraduate and postgraduate training of osteopaths and osteopathy students.	Not related to training of osteopaths or osteopathy students.
Manual style osteopathy, as is common in Europe.	Osteopathy as a medical profession as in the American context.
This includes "the learning environment" such as student and educator’s views about education.	Papers discussing education as a treatment modality or education of patients, by osteopaths
Published in English, Spanish, French, Portuguese or German.	Not published in English, Spanish, French, Portuguese or German.
	Full text not available online or when contacting the author.
All types and levels of primary evidence, qualitative, quantitative and opinion/commentaries.	Review articles and non-peer reviewed sources.

reducing reviewer bias and facilitated discussion regarding which data to include in the review [11]. Inter and intra-rater reliability of extraction was reviewed at two timepoints and deemed to be acceptable Cohen's Kappa >0.60, for all permutations of reviewers [12]. No amendments to the data extraction tool were undertaken.

Stage 5. Collating, summarising, and reporting the result

Due to the high yield of published research following our initial search, the level of evidence included was restricted to peer-reviewed published material. This was a deviation from our protocol and is discussed in the limitations section. Descriptions of the included papers and key themes and results were then independently extracted in duplicate by the review team.

Covidence software was used to summarise the included studies and combine the data extracted by each author and record the independent Risk of Bias (ROB) assessments, as well as facilitating consensus, where discrepancies or disagreements occurred. As ROB is a, somewhat, subjective concept and items are not equally weighted in some checklists [13], an overall categorisation is presented rather than a summed score, in keeping with the recommendations of Shea et al. [14]. ROB scores are presented as High, Moderate and Low. As the results may inform future decision making, a conservative approach to ROB was taken. Studies were rated with a stringent application of the criteria; disagreements were resolved by consensus and the mediation of a third reviewer.

We also note the limitations of the checklists utilised, as they are designed to assess medical research rather than educational research, therefore, not all questions were relevant for all papers. We chose to utilise Joanna Briggs Institute (JBI) checklists [15], due to the heterogeneity of the studies included in this review, to standardise the ROB assessment and reporting process with appraisal tools available from one source with similar guidance and outputs.

ROB itself is a contentious topic, beyond positivist and post-positivist paradigms, particularly regarding qualitative research [16] and commentary papers, which inherently express a viewpoint and the authors construction of knowledge. Therefore, bias as a concept is not strictly applicable and other ways of expressing quality are used [17,18]. We acknowledge this ontological and epistemological inconsistency, yet we feel this meets the requirements for a reproducible and robust method whilst allowing for meaningful, transparent construction and synthesis of mixed types of evidence.

ROB is not always presented within published scoping reviews [6,19,20], however, to assist in decision making and the utility of this review to inform educational delivery the additional step of ROB was deemed necessary, to provide a transparent view of the literature. Therefore, no minimum threshold of quality for inclusion was set.

The data were categorised into subjects or themes to enhance the utility of this review for the osteopathic educational community. Themes were constructed by the review team using the Critical Interpretive Synthesis Method [21,22].

The final included papers and data extracted are summarised in Tables 2–6.

Recommendations for research and practice were identified by consensus discussion amongst the review team, based upon our reading and assessment of the literature.

Recommendations for research and practice were identified by consensus discussion amongst the review team, based upon our reading and assessment of the literature.

3. Results

The search results and screening process is reported in Fig. 1. We retrieved 2676 records and 508 duplicates were removed, leaving 2168 records of which titles and abstracts were screened. Full texts were sought and screened for 147 records with 66 included in the final summary.

Table 2 Teaching.

Author and ROB	Setting/ Population	Design/ Methodology	Key Findings/ Results
Aubin et al., 2021 [24] Low ROB	Canada Centre Osteopathique du Quebec (COQ) 47 Students undergoing remediation process between 2013 and 2018. Female (n = 34; 72%), male (n = 13; 28%). Reasons for remediation-student's request (45%) and poor exam results (theoretical, and/or practical, and/or clinical reasoning exams) (44%) were the main reasons leading to remedial education. Other causes resulting in a pedagogical follow-up were: poor performance during supervised clinic (7%), weakness noticed by teaching staff (3%), and poor results to formative clinical case scenario (1%).	Cross sectional and retrospective cohort: Data was gathered by self-administered survey and students' educational files were reviewed.	The remediation process seems to have a positive impact with more than twice as many conclusive outcomes (70.5%; exam success, continuation of studies, or increased confidence level) than non-conclusive outcomes (29.5%: ongoing process, remediation ended due to lack of students' investment, issue partially resolved, end/suspension of studies, or final exam failure). Student surveys supported a positive experience in qualitative and quantitative data. Themes concerned self-regulated learning, palpation, and clinical reasoning processes.
Fitzgerald et al., 2019 [25] Low ROB	Australia: Victoria University, Students enrolled in a year 3 full-time student load in the Bachelor of Science (Clinical Science) in 2016.	Parallel group post-test design of an online learning package, offering a replacement to 50% of clinical placement hours.	Only one OSCE item was significantly different between groups, that being technique selection (p = 0.038, d = 0.72) in favour of the intervention group, although this may be a type 1 error. Grade point average was moderately positively correlated with the manual therapy technique station total score (r = 0.35, p < 0.01) and a trivial relationship with the treatment reasoning station total score (r = 0.17, p = 0.132). A significant difference with a large effect size (p = 0.048, d = 0.79) was observed with the simulation group (6.40 ± 0.36) having a higher GPA than

(continued on next page)

Table 2 (continued)

Author and ROB	Setting/ Population	Design/ Methodology	Key Findings/ Results
Fitzgerald et al., 2018 [26] Low ROB	Australia: Third year of the osteopathy course at Victoria University in 2017 were invited to participate in the study (n = 91). Seventy (n = 70) learners completed the demographic questionnaire, NPQ and HC-PAIRS pre-intervention at the commencement of the week 1 lecture in semester 1, 2017. Matched pre-post NPQ and HC-PAIRS data were available for fifty-five (n = 55).	Repeated measures cross sectional design. Neurophysiology of Pain Questionnaire (NPQ) and the Health Care Providers Pain and Impairment Relationship Scale (HC-PAIRS)	the control group (6.04 ± 0.52). The median NPQ score increased from pre- (10/19 correct answers) to post-intervention (14/19 correct answers) with a large effect size (p < 0.001, z = -5.71, r = 0.78). The median HC-PAIRS total score significantly increased pre (46/105) to post (65/105) intervention with a large effect size (p < 0.001, z = -6.79, r = 0.91) This was not strongly linked to demographics. The total HC-PAIRS score for this cohort increased significantly pre-post intervention indicating a decline in positive attitudes and beliefs towards patients with chronic low back pain. The results of the current study suggest a 12 week clinically focused pain module improves pain neurophysiology knowledge in year 3 osteopathy students, however a similar positive change was not reflected in the attitudes to those with chronic low back pain. Barriers to education in private practice include practitioner availability versus student availability; practitioners without knowledge and skills for clinical education; resource intensive logistical and educational processes. Nevertheless, students regarded the opportunity highly and report substantial improvement in clinical competence in this one setting. A
Moore & Field, 2017 [27] Low ROB	Australia: Eight students from three universities, a member of faculty of each and one private practice owner/manager participated in a study investigating pre-registration learning in private practice in Australia in 2012–2015.	In this case study individual interviews were conducted with faculty at three universities and, separately, with the owner or manager of the private practice. Students attending the practice were surveyed.	

Table 2 (continued)

Author and ROB	Setting/ Population	Design/ Methodology	Key Findings/ Results
Vaughan et al., 2017 [28] Low ROB	Australia: Commentary	Commentary: Regarding Near-peer teaching	featured learning strategy was the student Personal Learning Plan. Near-peer teaching involves students observing more experienced learners. This commentary describes the underpinning educational theory and how near-peer clinical education is used in osteopathy in the Australian context. Some challenges and opportunities of this approach are discussed. Near-peer clinical education has the ability to enhance a junior and senior students' clinical education, to strengthen the notion of a community of learning, and also to develop a student's ability to educate others - potentially developing future clinical educators. The authors suggest that the data gathered, through these programmes, could enable course managers and the regulator to monitor institutional profiles of professionalism teaching and learning. This study demonstrated feasibility for the wider use of this programme. Students reported a high level of satisfaction with the cases, but the filming could be improved. Students strongly agreed the learning outcomes had been met and were more confident in managing similar patients in future. The study showed feasibility of an online simulated
Browne et al., 2015 [29] Low ROB	UK. Consensus group of two senior faculty representatives nominated by their Deans or Principals from each of the 11 UK OEs and senior officers from the GOsC, with expertise in standards, the agreed inventory was tested on two groups of 4 and 12 osteopathy students.	Feasibility study regarding an e-learning professionalism resource. Focus groups to explore teaching of professionalism in pre-registration osteopathy.	
Fitzgerald et al., 2017 [30] Low ROB	Australia Case Study: Melbourne, ten (10) 3rd year students. Experienced osteopaths were recruited from the pool of osteopathy clinical educators.	Case Study, simulated consultation was recorded. The Simulated Learning (SL) activities had online support from a facilitator (acting in lieu of a clinical supervisor) and peers in the decision-making around the patient.	

(continued on next page)

Table 2 (continued)

Author and ROB	Setting/ Population	Design/ Methodology	Key Findings/ Results
Aubin et al., 2014 [31] Low ROB	Quebec Canada: Commentary	Commentary: Regarding palpation	learning system which provides a consistent student experience and may be a cost effective alternative or addition to traditional clinical experiences. This paper discusses the “Seven-Step Palpation Method” which aims at achieving greater autonomy for student’s training. To enhance their learning process, it follows a set process of teaching to build consistency amongst staff delivering sessions. It is informed by educational theory such as case load and motor learning and perceptual theory. The teaching method insists on external focus as well as self-controlled practice and divides motor tasks in smaller parts. Author’s opinion regarding the range of skills required for osteopathic students to develop palpatory expertise and how the development of these skills can be optimized. Based on findings from own research examining the neural and behavioural correlates of diagnostic expertise in osteopathy and on evidence from the fields of cognitive neuroscience, experimental psychology, and medical cognition.
Esteves & Spence, 2014 [32] Low ROB	Commentary	Commentary: Regarding palpation	A discussion of the use of evidence and critical thinking and how to integrate them into osteopathic education as well as the challenges of integrating evidence and osteopathic
Fryer, 2008 [33] Low ROB	Commentary	Commentary: Regarding critical thinking and evidence in osteopathy.	A discussion of the use of evidence and critical thinking and how to integrate them into osteopathic education as well as the challenges of integrating evidence and osteopathic

Table 2 (continued)

Author and ROB	Setting/ Population	Design/ Methodology	Key Findings/ Results
Launay et al., 2021 [34] Moderate ROB	France: Institut d’Osteopathie de Rennes - Bretagne France. A cohort of 68 s-year osteopathic students were allocated to three groups (pseudo-randomisation). Each group were separately taught the same practical course but provided with different types of revision materials (video, digital data sheet or no material).	Quasi randomised cohort study. The three groups separately followed the same practical class and were allocated different revision materials: video resources (referred to as the Video group), no materials at all (the No Materials group) or a digital technical data sheet (the Digital Data Sheet group).	teaching. The paper closes with a case study suggesting strategies to navigate the conflict between traditional theory and evidence. The effect on practical exam results of the different revision materials was found to be significant (p < 0.01). More precisely, the post hoc tests suggested that the overall grades in the final assessment in the Video group (14.4 ± 1.8) were significantly higher than the No materials group (12.7 ± 1.8) (p = 0.04, d = 0.94) and the Digital Data Sheet group (11.2 ± 2.8) (p < 0.01, d = 1.36). No significant differences were observed between the No Materials group and the Digital Data Sheet group (p = 0.08, d = 0.64). The satisfaction questionnaire showed that half the students in the Digital Data Sheet group (53%) who had access to the digital data sheets when revising felt they were “not very satisfied” or “moderately satisfied” with the experience, even though 71% considered the material to be “satisfactory” (59%) or “very satisfactory” (12%). Moreover, 65% thought that the digital data sheets had not provided any additional benefit compared to their traditional revision material (i.e., the paper data sheets). Regarding the video-based revision materials, the results showed

(continued on next page)

Table 2 (continued)

Author and ROB	Setting/ Population	Design/ Methodology	Key Findings/ Results
			that 100% of the Video group students “liked” the material (21.7%) or “liked it very much” (78.3%). They found the video material “very satisfactory” (65.2%) or “satisfactory” (34.8%). More specifically, the main feedback comments mentioned that the video material helped them “remember” better (70%), enhanced their performance and effectiveness (13%) and gave them more confidence (18%) on the day of the exam.
Diaz & Woolley, 2021 [35] Moderate ROB	Australia: James Cook University (JCU), Royal Melbourne Institute of Technology (RMIT) University, La Trobe University, and Charles Sturt University (CSU). Osteopathy, chiropractic and Chinese medicine students. Three hundred and eleven (311) health science students across years 1 and 2 responded to the end of year surveys over 3 years (overall response rate = 30%, mean age 21 years, with 188 (61%) female respondents. Three student focus groups (n = 13) explored the key survey findings.	An explanatory mixed-methods approach. Towards the end of an anatomy course involving Body Painting (BP). The survey assessed the effectiveness of BP as a hands-on, group-based approach for learning in practical class.	Survey 72% positive response for BP helping to learn. Focus groups: Not all students will participate in self-directed BP activities, though more students will participate over time. BP Takes time and works best as a supplementary activity This study supports the use of student-centred teaching and learning methods including flexible, experiential, and self-directed learning.
Tripodi et al., 2020 [36] Moderate ROB	Australia: Victoria University Australia. First-year osteopathy students (N = 111) who were enrolled in the unit Scientific Basis for Osteopathy 1 (SBO1) in semester 1, 2018 completed the survey and eight (n = 8) students	A two-part mixed-method sequential exploratory design. Cross sectional survey and focus group. To assess student perceptions of using printed anatomical models.	The participants reported a high level of use, engagement; and overall benefit when asked about their thoughts on the models. Using a Chi-Square Goodness-of-Fit Test, all survey answers were found to be strongly positively

Table 2 (continued)

Author and ROB	Setting/ Population	Design/ Methodology	Key Findings/ Results
D’Alessandro et al., 2019 [37] Moderate ROB	Italy, osteopathy students Web based survey, from the 11th of September to October 2017. The study protocol was initially presented to all member schools of AISO (n = 19) and 17 of these agreed to participate. Among these 17 schools, 14 (82.35%) effectively sent the web-link to access to the survey to the students. A total of 268 students participated to the survey showing a response rate of 10.51% (268/ 2549 e-mails sent). All of the respondents completed the survey (completion rate = 100%; n = 268/ 268). The mean age was 27.69 (5.52); of the respondents 138 (51%) were males.	Cross sectional web-based survey 2 researchers independently developed a list of items in Italian language which were considered significant in order to investigate the students’ attitudes towards self-directed practice (SDP) during school summer break.	skewed (P < 0.001). Qualitative themes support that the models were viewed positively. 94/268 students (35.08%) did not perform SDP during the summer break. The reported reasons were ‘lack of appropriate place’ (42/94, 44.68%), ‘lack of subjects to exercise with’ (40/94, 42.55%) and ‘lack of time’ (36/94, 38.30%). No students reported that ‘the self-direct practice was useless. 174/268 students (64.92%) reported they performed SDP during the summer break and considered it useful (97.13%; n = 169). Ninety-eight respondents out of the 174 who reported SDP (56.32%) declared not sufficiently practicing during the period and among these 98 stated they would have practiced more SDP and reasons were ‘lack of people to exercise with’ (50/ 94 = 53.19%), followed by ‘lack of time’ (43/94 = 45.75%) and ‘lack of appropriate location’ (38 out of 94 = 40.43%). Students performed SDP between 1 - 5 h per week (59.20%; n = 103). The most frequent difficulty was ‘the interpretation of osteopathic tests’ (n = 164; 94.25%); the less frequent difficulty was ‘the relationship with patients’ (n = 84 = 48.28%). When the students were in difficulty, they sought assistance mostly from ‘a peer’ (27.35%), followed by ‘a more expert osteopath’ (21.80%), ‘a

(continued on next page)

Table 2 (continued)

Author and ROB	Setting/ Population	Design/ Methodology	Key Findings/ Results
			teacher' (9.83%), 'a senior student' (7.69%), 'a healthcare professional' (7.26%). A quarter of students (26.07%) did not ask for any help. Regarding SDP evaluation the 69.54% of students (n = 121) evaluated the level of their SDP using a self-evaluation method (73.55%; n = 89) rather than other methods such as peer feedback (14.05%; n = 17). expert student feedback (6.61%; n = 8) or expert osteopath (5.79%; n = 7). 46.55% (n = 81) reported a decrease in their SDP during the summer break; 32.18% (n = 56) reported an increase in their SDP and 21.27% (n = 37) reported no changes in the frequency their self-reported activity compared to the rest of the year. Most of the students (70.16%; n = 136) performed SDP at parents or a friend's studio.
Tripodi, 2018 [38] Moderate ROB	Australia: First year osteopathy students enrolled in the Osteopathic Science 1 and 2 units (n = 114) in the Bachelor of Science program at Victoria University (Melbourne, Australia) were invited to participate in the survey and focus groups. 74 students completed the surveys 12 students took part in the focus groups.	Mixed methods Questionnaire-based surveys and focus groups were used to examine use of video resources and student perceptions. Surveys were analysed based on the frequency of responses made on a 4-point scale. Thematic analysis was performed on long-answer survey and focus group transcripts.	Seventy-four (n = 74) students (40 Male, 34 Female) completed the survey, representing a 65% response rate. Twelve (n = 12) students (7 Male, 5 Female) took part in the focus groups (11%). The mean was age 21.2 years old. Thirty-nine participants had completed other post-Year 12 study, while 35 had not. Use of online videos - Students appeared to access the online videos the most when preparing for exams and to review difficult techniques. Conversely,

Table 2 (continued)

Author and ROB	Setting/ Population	Design/ Methodology	Key Findings/ Results
			students were less likely to use the videos before class and after class. Students differed on whether they used the videos to learn techniques they could not practice in class. Perception of online videos - Most students appeared to find the online videos easy to locate, easy to play and of good viewing quality. The students reported the online videos strongly helped them review material from class, prepare for exams and learn independently. Students also found the online videos beneficial to their study motivation and reduced the need to take notes during class time. The students appeared to find the online videos very beneficial for their practical exam performance, for reducing their pre-exam anxiety and for their exam confidence. Students also thought that online videos should be used in other subjects. The students were unanimous in their response that the online videos improved their learning experience in the unit. Quantitative and qualitative data comparison- When comparing positive and negative responses between the surveys and interviews, the data showed that students answered Survey 1 slightly more positive (55.1%) than negative (44.9%). There was an increase in positive responses for

(continued on next page)

Table 2 (continued)

Author and ROB	Setting/ Population	Design/ Methodology	Key Findings/ Results
Browning, 2014 [39] Moderate ROB	United Kingdom, Australia and New Zealand. Focus group and survey. 14 Senior osteopathic educators.	Delphi study, using snowball sampling. A workshop at a conference was used to generate statements that would form the first section of the round one modified Delphi method questionnaire. Following a brief introduction, the workshop began as a focus group meeting and concluded as a nominal group technique meeting.	Survey 2 (88.1%). The total positive responses for the focus groups made up 76% of the coded answers. Participants stated: Students do not actually feel with any more discrimination in their fingertips than anyone else. However, they are able to relate what they feel to the "norm" that they establish with many hours of practice. They discuss the importance of experiential learning. Several statements were generated, and agreement was measured. Experts favour elements from several educational theories. Constructivism (including Vygotsky's Zone of Proximal Development and Lave and Wenger's Communities of Practice) and the Design-based theory. The consensus of the experts is that palpation classes should be non-judgemental and encourage free discussion (tutor/ student and student/student). Initially, no consensus was reached regarding exploring 'innocently without direction' but consensus was reached when integrated within class structure.
Lalonde, 2013 [40] Moderate ROB	Commentary	Commentary: Regarding Problem Based Learning (PBL)	The paper discusses that PBL begins with a problem or case study presented to a small group of students. It usually comprises a description of a phenomenon or situation that a professional practitioner might encounter.

Table 2 (continued)

Author and ROB	Setting/ Population	Design/ Methodology	Key Findings/ Results
Wong, 2022 [41] High ROB	Australia: Osteopathy students in year two of the program at Victoria University, Melbourne, Australia, were invited to participate. Seventy-six (76) second-year osteopathy students participated.	Cross sectional survey: Twelve pathology lectures were divided into subtopics of 12–20 min duration. After each sub-topic, a short- answer question was posed to the class for consideration using the think-pair-share approach. A post-test survey assessed engagement and perceptions of the teaching strategy.	Participants reported significantly higher levels of engagement (p < 0.001) following instruction with think-pair-share. There was no significant difference in grades for participants (M = 71.17, SD = 10.09) and students in the previous cohort (M = 69.77, SD = 11.76. Qualitative feedback on the think-pair-share strategy was largely positive: perceived benefits to learning emerged as a dominant theme. Learners also valued the collaborative nature of this teaching strategy. Engagement and grades were not statistically significantly correlated.
Lavazza et al., 2018 [42] High ROB	Italy: 82 examiners with different years of experience were enrolled from AIMO institute in Italy. Students from the 3rd, 4th, 5th year of Osteopathic school were involved.	Quasi-experimental design: Two distinct types of training sessions were performed (individual and group training). A total of 5 training sessions were performed for 5 weeks and 5 different models with a similar BMI were used. Five models, one man and four women, with a normal BMI (mean 21.7, SD1.23) were recruited. Training sessions addressed palpation skills.	Overall results show moderate reliability for the correct detection of the position of the heel lift (Random probability being 33%, GT 58.6% and SIPS 57.1%, both P-value <0.001). No difference was shown between the types of training (p-value GT 0.503, p-value PSIS = 1) and no overall improvement was shown after the first training (P-value (GT) 0.25, P-value (PSIS) 0.96). The professional group improved the reliability during the training sessions starting from substantial reliability and ended with an almost perfect reliability (P-value GT0.0029, P-Value PSIS<0.001). Whereas the 3rd, 4th and 5th showed a decreased performance. The main investigators

(continued on next page)

Table 2 (continued)

Author and ROB	Setting/Population	Design/Methodology	Key Findings/Results
Zegarra-Parodi et al., 2009 [43] High ROB	France: Fourth-year osteopathy students from the European Center for Osteopathic Higher Education in Paris, were recruited and randomly divided into three groups of 12 students.	Quasi-Experimental Students in the study group received instruction in a standardized protocol for palpatory assessment of the frontal-malar suture; students in the control group did not receive instruction; and the remaining students acted as subjects.	noticed that the importance given to the trial by students was lower than expected, there was 33% dropout, all among students. Palpatory training was ineffective in improving student practitioners' precision of cranial palpation performance. The palpation pressures recorded throughout the study procedure ranged from 0.19 to 1.12 N/cm ² mean pressures of the 2-second tests ranging from 0.27 to 0.98 N/cm ² . The mean (SD) palpation pressure recorded by the control group was 0.53 N/cm ² (0.16 N/cm ²). The mean (SD) pressure recorded by the study group was 0.55 N/cm ² (0.15 N/cm ²) (95% CI, 0.5–0.6 N/cm ²) The coefficient of variation for the control and study groups was 29% and 28%, respectively. No statistically significant difference was found between the two groups (z = 0.55, P = 0.58). There was considerable inter group variation.

The included studies were assessed for ROB in duplicate and have been judged as low, moderate or high ROB. Results were grouped into categories by topic; Teaching, Assessment, Clinical education and preparedness for practice, Curriculum and Miscellaneous. These topics are presented in individual tables with a narrative topic summary of each table and a critical interpretive synthesis discussing the totality of the evidence is also presented [21].

Fig. 2 summarises the publication dates of the included articles, showing no articles published prior to 2002 were retrieved. This was despite no date limitations being imposed upon the search. The number of papers published in each year ranges from 1 to 11. The mean number of annual publications is 4.1 (SD = 2.94), the median is 3.5 (IQR = 5.5) with a variance of 8.6.

The evidence is generally of robust methodological quality, with ROB rated as 29 Low, 26 Moderate, and 11 High. However, most of the

Table 3

Clinical education and Preparedness for practice.

Author and ROB	Setting/Population	Design/Methodology	Key Findings/Results
Vaughan, 2020 [44] Low ROB	Australia: Questionnaires were received from 37 clinical educators. These were matched with 308 student evaluations, in the Victoria University (Australia) during semester 2, 2017.	Cross sectional Survey. Osteopathy Clinical Teaching Questionnaire (OCTQ) and Self-Efficacy in Clinical Teaching (SECT).	Three possible educator cohorts were identified: High clinical educator self-OCTQ with low student evaluation; low clinical educator self-evaluation and high student evaluations; and no difference between self- and student evaluations. Clinical educators in the first cohort demonstrated significantly higher SECT subscale scores (effect size >0.42) than their colleagues. Age, gender, teaching qualification, and years practicing or years as a clinical educator were not associated with clinical educator OCTQ scores or the SECT subscales. Twenty-four educators (66.7%) had a lower difference score (i.e., clinical educator self-OCTQ was less than student OCTQ score) and eleven (30.6%) had a higher difference score with one educator (2.8%) demonstrating equal scores. The median difference score was 1.95 (range 12–16) and no significant difference was identified for the number of student ratings per educator and the difference score category. Demographic data were not statistically significantly different. Attitudes to Evidence Based Medicine (EBM) and practice were largely positive. The student EBPQ Practice subscale was significantly improved pre-post intervention. None of the other subscales were significantly different. Focus groups confirmed
Vaughan et al., 2019 [45] Low ROB	Australia: Southern Cross University senior osteopathy students and their clinical educators. Data were received from 30 students on initial administration of the survey (male: n = 17, 56.7%) and matched data for 16 students representing	Pilot study using a cross sectional survey Evidence based practice questionnaire (EBPQ) and Focus groups.	

(continued on next page)

Table 3 (continued)

Author and ROB	Setting/Population	Design/ Methodology	Key Findings/ Results
	30.8% of the total year 4 and 5 cohort was available following the second administration. Three focus groups (two student focus groups of nine (9) students each and one focus group of six (6) clinical educators).		the increased use of EBM and the Summarise the case, Narrow the differential, Analyse the differential, Probe the clinical educator, Plan the management, and select and research an aspect of the case for self-directed learning (SNAPPS-Plus) model provided a structure that improved the efficiency and effectiveness of student's literature searches. Focus groups highlighted the different value educators and students placed on research evidence and clinical experience. Four key themes were identified across the three groups: Building a culture of EBM in student-led clinic; Helping students develop research skills; Weighing up the value of clinical practice and research evidence in clinical decision making; creating a learning environment for students and clinical educators.
Clarkson & Thomson, 2017 [46] Low ROB	UK: Final year osteopathy students (N = 8) from 2 OELs in October 2016–January 2017.	Qualitative interviews using constructivist grounded theory	Final year osteopathy students held differing professional identities, and four categories were constructed which describe this variation, these were: approach to patient care, view of osteopathy, learning experience and view of practical skills. Students' professional identities varied in their stages of development and related to three points along a professional identity continuum and are in accordance with role transition theory.
Vaughan & Macfarlane, 2015 [47] Low ROB	Australia: 72 Students in the first year of the osteopathy	Cross sectional survey using the Practical Class Teaching	Statistically significant differences in mean ratings ($p < 0.05$)

Table 3 (continued)

Author and ROB	Setting/Population	Design/ Methodology	Key Findings/ Results
	program at Victoria University on completion of week 5 and week 12 of semester 1 (February 2013 and May 2013).	Questionnaire (PCTQ). Students were asked to rate the academic tutors (ATs) and near-peer tutors.	between tutor types were noted at week 5. These differences had largely been ameliorated by week 12. There is a strong relationship between the total PCTQ and a global rating of teaching quality. R squared 0.755 ($r = 0.869$, $p = 0.01$)
Luciani et al., 2021 [48] Low ROB	UK, Italy, France: A questionnaire was sent by e-mail to 179 final year students of three osteopathic schools in June 2011. All final year students of the British School of Osteopathy (BSO-UK), Accademia Italiana Osteopatia Tradizionale (AIOT-Italy) and Centre Europe len Enseignement Supérieur de l'osteopathe (CEESO-France). The response rate was 58% for the BSO (n = 51), 100% for the AIOT (n = 12) and 80% for the CEESO (n = 63).	Cross sectional survey	The learning environment was considered, more positive than negative across all of the schools. The student's perception of learning (SPL), students' perception of teachers (SPT), students' perception of atmosphere (SPA) and students' social self-perception (SSSP) were the same for all three schools. In contrast, students' academic self-perceptions (SASP) were as confident for the AIOT, and a positive feeling for the BSO and CEESO, which was significantly different between schools, ($F(2, 123) = 5.64$, $p = 0.005$). A post-hoc Tukey test showed that BSO was lower than AIOT (M = 3.63; CI 6.63, 0.63; $p = 0.01$) and CEESO was higher than BSO (M = 1.91; 95% CI 0.15, 3.67; $p = 0.03$). SPA was significantly different between schools, ($F(2, 123) = 3.24$, $p = 0.04$). Specifically, BSO was lower than AIOT (M = 4.35; 8.69, 0.01; $p = 0.049$) and CEESO was lower than AIOT (M = 4.44; 8.71, 0.18; $p = 0.04$). The AIOT students perceived a better learning environment than CEESO and BSO students, while CEESO students felt more prepared than AIOT and BSO students. Statistically significant associations were found between

(continued on next page)

Table 3 (continued)

Author and ROB	Setting/Population	Design/Methodology	Key Findings/Results
Vaughan, Carter et al., 2014 [49] Low ROB	Australia: Students in all year levels of the osteopathy program. Victoria University. All students enrolled in semester two, 2013 247 students Year 1: 75/76 (98%); Year 2: 51/56 (91%); Year 3: 34/44 (77%); Year 4: 45/54 (83%); Year 5: 42/45 (93%).	Survey: Dundee Ready Education Environment Measure (DREEM) a 50-item questionnaire to measure the environment in health professional education programs.	learning environment and preparedness. The environment is comparable to other Australian allied health programs and to the final year of osteopathy programs in the UK and France. There was no relationship observed for age, highest level of education achieved or whether the students' previous program had a clinical education component and total score.
Johnston & Vaughan, 2020 [50] Moderate ROB	Australia: Victoria University. Thirteen first year students in 2016.	Focus group	Students perceived anatomy to be a particularly important component of their learning. This was reinforced by the student's desire for additional anatomy contact hours. Curriculum integration appeared to be a source of confusion. The students did not see a logical progression from one lecture to the next and how the topics related to each other. Case based learning provided context and assists with assimilating knowledge but did not aid anatomy learning.
Quesnay et al., 2021 [51] Moderate ROB	France Eight (8) OEIs in France January to October 2019. The respondents worked either as education coordinators (n = 6/8) or held leadership positions (n = 2/8).	Cross sectional survey: Online questionnaire. Determine teaching, Learning and assessment methods related to relational competency and identify the role of patient education in this.	The aim of this study was to determine the teaching, learning, and assessment methods related to relational competency in French initial training programs and identify the role of patient education within this relational competency. Seven respondents (88%) considered relational

Table 3 (continued)

Author and ROB	Setting/Population	Design/Methodology	Key Findings/Results
Haworth et al., 2021 [52] Moderate ROB	Australia. Final Year Students from 2 chiropractic and 2 Osteopathic (N = 13) programmes from 4 Australian Universities.	A qualitative exploratory descriptive design was used. With multiple and repeated case studies (interviews).	competency as being just as important as other clinical competencies. The relational competencies appeared in various courses, enhanced by clinical learning. However, the courses were not specific to this competency and the volume of hours was relatively low. Patient education was seen as part of relational competency but was poorly implemented. This competency-based approach is still considered an emerging practice in these institutes. Students perceived that community clinics or private practices prepared their readiness for transition to practice substantially better than student led clinics. Community clinics and private practices allowed students to consult people from diverse socioeconomic and cultural backgrounds and treat complex health care issues; and the model of supervision allows students a degree of autonomy. Students lacked a clear understanding of the behaviours that demonstrate their professionalism. Interprofessional learning activities were ad hoc and opportunistic. Most students feel prepared for practice.
Hartup et al., 2010 [53] High ROB	Australia: 19 Osteopathic students at RMIT at varying levels of the course.	Qualitative Phenomenology	5 main stages were constructed: Acceptance into and Commencement of the Program; Progression through the Program; Clinical Experience; The Master's Program; and Looking Beyond Graduation to the Future. Each provoked varied emotional responses

(continued on next page)

Table 3 (continued)

Author and ROB	Setting/Population	Design/Methodology	Key Findings/Results
Robertson et al., 2002 [54] High ROB	Australia: The Osteopathic Medicine Clinic, Victoria University, Participants: 100 patients and 152 senior clinical students and graduates A total of 152 questionnaires were distributed of which 52% were completed and returned. 29% of respondents were graduates, 44% were 5th year, 46% were 4th year and 73% were 3rd year. Of all respondents, 44% were male and 56% were female which represents the gender distribution within this population of	Questionnaire based study. Student and patient perspectives of Outpatient teaching.	forming the major themes; Stress and Anxiety, Happiness and Excitement, Contentment, Self-Satisfaction, Frustration, Fear of Failure and Self-Doubt, Sense of Support, Anger and Resentment, Fear of the Unknown and Sadness. The most prevalent emotional experience reported was that of stress and anxiety within the student's journey. While this was of great significance, it was concluded that a student's underlying passion for osteopathy and strong friendships formed within the program are what enable the student to get through the challenges and difficulties associated with undertaking the osteopathic program. One of the most significant challenges described was that of attempting to establish and maintain a balance between commitment to osteopathic study and outside life. 96% of students found out-patient teaching to be a valuable way of gaining professional skills. 92% strongly agreed or agreed that out-patient teaching is an effective way to develop skills in history taking, conducting physical examinations (87%), enhancing communication skills (85%), and to develop record keeping (72%) and time-management skills (60%). The preferred location for the presentation of patient cases was in the tutorial room away from the patient. 100% of patients indicated that they were

Table 3 (continued)

Author and ROB	Setting/Population	Design/Methodology	Key Findings/Results
	students and graduates. The mean age was 25 (age range 20–47 years).		comfortable with the history taking in the out-patient setting with 84% of patients indicating that their experience of out-patient teaching would make them more likely to refer other patients. 96% of patients indicated that out-patient teaching did not make them anxious with 84% reporting that the clinical discussion of their case increased their knowledge of their clinical problem. 27% of patients suggested that there were some aspects of the clinical discussion that they didn't understand with 4% of patients finding that some discussion was inappropriate.

methodological designs would traditionally be considered low on the hierarchy of evidence, with 19 commentary articles and the only Randomised Controlled Trial being rated High ROB. A full description of the types of evidence is in Fig. 4.

There is a clear trend in publication by geographical region with 39% of the literature being in an Australian setting, twice as much as the next closest region, the UK, as shown in Fig. 3.

The evidence regarding teaching in osteopathy, Table 2, is heterogeneous in methodology topic and is of mixed methodological quality. Twenty (20) papers were included in this category, ten (10) of which are low ROB. The acquisition of palpatory skills was a recurrent theme in this section (4 of 20), however, interventions did not appear to alter palpatory ability. Novel pedagogical approaches such as Problem Based Learning (PBL), peer learning, body painting and use of printed anatomical models is discussed. Online, virtual or e-learning is an approach valued by learners, evidence reviewed suggests; experiential, self-directed but flexible learning is preferred by students.

Table 3 discusses clinical education and preparedness for practice, elements of the data could be presented within the teaching category, as there is undoubtedly overlap. However, the investigations used cross sectional surveys and qualitative interviews and therefore, primarily present data regarding perceptions of teaching and the learning environment. The evidence regarding clinical education and preparedness of practice is heterogeneous. Students overall, perceive a positive experience; however, high levels of anxiety are often present and there is uncertainty regarding future practice and preparedness for practice. Clinical placements are seen as valuable sources of learning, but this learning may be perceived as poorly planned or lacking constructive alignment.

Table 4 summarises the evidence regarding Assessment, which is an important and challenging area in osteopathic education. Assessment takes a variety of forms from standardised academic assessments, such as essays and written examinations to portfolios and clinical/practical examinations. OEIs appear to have challenges in facilitating robust examinations which are both cost effective, valid, and reliable. The

Table 4
Assessment.

Author and ROB	Setting/Population	Design/Methodology	Key Findings/Results
Vaughan et al., 2014 [55] Low ROB	Australia: Commentary	Commentary: Regarding the process of developing the portfolio which will be introduced to the year 5 osteopathy students at the beginning of the first semester of 2012 and be assessed in the examination period at the end of semester 2, 2012.	This commentary discusses the benefits and challenges of implementing portfolio assessments in osteopathy. Portfolios may enhance reflective learning. This paper is a discussion of the introduction, structure, mentoring and assessment of the portfolio along with how the implementation of the portfolio will be reviewed.
Moore et al., 2014 [56] Low ROB	Australia, New Zealand, UK: Representatives from Southern Cross University, Victoria University, Unitec, New Zealand and the British School of Osteopathy, in 2014.	Qualitative: Study to benchmark the assessment strategy used for clinical reasoning across the final two years of the clinical components of four osteopathic programs. Learning objectives and clinical assessments from the final two years in each of the four programs were analysed to identify the types and frequency of assessments and the degree of alignment between learning objectives and Bloom's taxonomy and Miller's hierarchy. Types of assessment tools were collated and compared across all osteopathic programs. The learning objectives related to each tool were reviewed to determine how they were used in each program.	All institutions assess clinical reasoning in a variety of ways such as practical observation; the assessment of simulated performance; the clinical supervisors report and oral or written reports. The results show that the osteopathy teaching institutions did not scaffold the expected learning objectives to reflect an increase in difficulty as the student progresses; the learning objectives tend to be clustered and relatively stable. However, this may reflect only investigating the final years of an osteopathic teaching program.
Esteves et al., 2013 [57] Low ROB	UK: Commentary: Oxford Brookes University. Twenty expert clinicians were involved, all had been in clinical practice for a minimum of 8 years and in osteopathic education for a minimum of 5 years.	Commentary: Regarding the development of a new assessment tool, a Script Concordance Test (SCT) in undergraduate education.	The construction of the SCT involves two or more experienced clinicians writing clinical scenarios, suggesting a hypothesis and introducing additional clinical information. Students are presented with a series of tasks,

Table 4 (continued)

Author and ROB	Setting/Population	Design/Methodology	Key Findings/Results
Vaughan et al., 2012 [58] Low ROB	United Kingdom, Canada, Italy and Australia Twenty-five participants across eleven osteopathic teaching institutions.	A series of focus groups and interviews were conducted, with staff, regarding which methods of assessment were used.	which represent authentic clinical situations and are described in vignettes. Each vignette does not contain all the data required to provide a solution and several options (e. g., diagnosis, management) should be considered. Students are required to make a judgment based upon the limited available clinical information, using a Likert scale. Students must decide whether the new information makes the hypothesis much less likely, less likely, ineffectual, more likely or much more likely Four themes were identified from the focus groups: Assessing; Processes; Examining; Cost Efficiency. Institutions utilised assessment types such as multiple-choice questions and written papers in the early years of a program and progressed towards the long case assessment and Objective Structured Clinical Examination in the later stages of a program. Although examiner cost and training were common themes across all the institutions, they were perceived to be necessary for developing and conducting assessments.
Abbey, 2008 [59] Low ROB	UK, British School of Osteopathy.	Retrospective cohort study 1998–2000 n = 240 2004–2006 n = 228 Statistical analysis of grades from FCCA and Clinic Tutor Reports for 6 cohorts of students graduating in 1998–2000 and 2004–2006.	Mean scores for CTRs were higher than FCCAs in 1998–2000 with divergence increasing in 2004–2006 and fewer students failing CTRs. Correlation between FCCA and CTR grades was low in 1998 (rs0.34, p

(continued on next page)

Table 4 (continued)

Author and ROB	Setting/Population	Design/Methodology	Key Findings/Results
			<p>< 0.01) and decreased to non-significance by 2000 (rs0.17, p > 0.05). However, correlations increased steadily from 2004 (rs0.38, p < 0.01) to 2006 (rs0.67, p < 0.01). Academic Knowledge was the only individual assessment item which was strongly correlated with Overall CTR grade and FCCA results in 1998–2000 but was not a separate assessment item in 2004–2006. In 1998 approximately 11% of FCCA grades could be predicted by students CTR grades but in 2006 this had increased to 45%. Few students fail CTR but many fail FCCA. Statistical analysis demonstrated weak correlations between FCCA and CTR grades in 1998, however, correlations were stronger in later cohorts. These findings may be evidence of increased concurrent validity due to changes in governance and format of FCCA in the UK and corresponding changes in BSO assessments. However, there is also a possibility that the results demonstrate a narrowing focus in clinical competence assessments, possibly emphasising cognitive criteria to the exclusion of other important attitudinal domains. Comparison of FCCA and CTR grades Year 2004 (n81) 2005 (n79) 2006 (n68) Mean FCCA grade (SD)</p>

Table 4 (continued)

Author and ROB	Setting/Population	Design/Methodology	Key Findings/Results
			<p>9.30 (3.49) 8.92 (3.72) 8.81 (2.94) Mean CTR grade (SD) 11.60 (2.72) 11.62 (1.84) 12.10 (1.85) Median FCCA grade 8 Low C 7 High D 7 High D Median CTR grade 9 Mid C 9 Mid C 10 High C Difference 0.33 grade 0.66 grade 1.00 grade. 67% of respondents suggest peer assessment should not form part of grading and 63% that near peer should be less than 25% of grading. Correlations between self and peer (r = 0.38) and self and faculty (r = 0.43) marks were moderate. A weak correlation was observed between self and NP marks (r = 0.25).</p>
Fitzgerald & Vaughan, 2018 [60] Moderate ROB	Australia: Victoria University, February 2016 to November 2016 Year 2 osteopathy students (n = 86), Near Peer (NP) instructors (n = 4); and: faculty instructors (n = 14). Year 2 students (n = 9), NPs (n = 3), and faculty (n = 5) were recruited for the assessment-marking component of this study.	Cross sectional survey. Attitudes to peer and near peer assessment. and correlation between self, peer, near peer and faculty grading.	
Vaughan, Orrock et al., 2017 [61] Moderate ROB	Australia: Reliability of a viva assessment of clinical reasoning in a pre-professional osteopathy program assessed using generalizability theory.	Reliability of a viva assessment of clinical reasoning in an Australian pre-professional osteopathy program assessed using generalizability theory.	The examination produced a generalizability coefficient of 0.53, suggesting that 53% of the variance in the students total score was attributable to real differences in student performance on the examination. To ensure greater reliability 18 stations are required to achieve a generalizability coefficient of 0.80. The greatest variance was attributable to residual and systematic error. The examiner and student examiner facets both contributed approximately 20% of the variance, suggesting that the examiners were a substantial contributor to a student's score. The study suggests that students can judge another student's consultation skills and case
Moore & Vaughan, 2017 [62] Moderate ROB	Australia: Victoria University in 2014. All 52 students enrolled in year 5 (final year) of the osteopathy	Students undertook, without training, peer assessment and provision of feedback related to	

(continued on next page)

Table 4 (continued)

Author and ROB	Setting/Population	Design/Methodology	Key Findings/Results
	programme at VU were required to complete a minimum of two mini- CEX (Clinical examination) assessments on a year 5 peer as a progression requirement. The assessment was not summative and did not contribute to the grade for their clinical subjects.	clinical performance using discipline specific adaptation of the mini- CEX.	management in that they identify common learning issues. Students may be willing to engage in peer assessment if they see the exercise to improve patient care and to develop their skills as educators potentially encouraging them to become clinical educators in the future.
Noyer et al., 2017 [63] Moderate ROB	UK: UCO London England. Sixteen (16)pre-registration osteopathy students.	Single-blinded, cross-sectional study. two within-subject variables, context control versus complex and concept type (literal, inferred and filler) was employed. The dependent variables were participant mean response time (RT) and mean error rate (ER) per concept type.	Participants made significantly more errors when judging literal concepts and took significantly less time to recognize filler concepts in the complex context. No significant difference in ability to judge inferred concepts across contexts was found. There was a significant main effect of context, $F(1, 15) = 11.87, p = 0.004, \eta^2 = 0.442$, and concept type, $F(2, 30) = 5.37, p = 0.01, \eta^2 = 0.264$. The interaction between context and concept type was significant, $F(2, 30) = 7.29, p = 0.003, \eta^2 = 0.327$. Post-hoc Bonferroni-adjusted t-tests showed that subjects made significantly more errors when judging literal concepts in the complex context ($M = 47.7, SD = 12.3$) compared to the control context ($M = 22.7, SD = 17.8$), $t(15) = -4.57, p < 0.001$. There was no significant difference in ER between contexts for inferred ($p = 0.30$) and filler ($p = 0.46$) concepts. Participants made significantly fewer errors when judging literal concepts ($M = 22.7, SD = 17.8$) compared to filler concepts ($M = 43.8, SD = 13.9$) in the control context, t

Table 4 (continued)

Author and ROB	Setting/Population	Design/Methodology	Key Findings/Results
			(15)= -3.70, $p = 0.002$. The difference in ER between inferred and literal concepts ($p = 0.02$) and between inferred and filler concepts ($p = 0.08$) in the control context was not significant. There was no significant difference in ER across concept types in the complex context ($p > 0.0055$). Post-hoc Bonferroni-adjusted t-tests showed that sub-jects took significantly less time to judge filler concepts when placed in the complex context ($M = 2119, SD = 680$) compared to the control context ($M = 2541, SD = 935$), $t(15) = 3.29, p = 0.005$. Difference in RT between contexts for inferred ($p = 0.06$) literal ($p = 0.13$) concepts. Participants judged filler concepts ($M = 2541, SD = 935$) significantly slower than inferred ($M = 2113, SD = 765$), $t(15) = -4.45, p < 0.001$, and literal concepts ($M = 1922, SD = 711$), $t(15) = -3.87, p = 0.002$, in the control context. The difference in RT between literal and inferred concepts in the control context ($p = 0.22$). The difference in RT across concept type in the complex context ($p > 0.0055$)
Vaughan & Morrison, 2015 [64] Moderate ROB	Australia: Commentary	Commentary: Regarding, assessment in Australia.	This commentary provides an overview of the current assessment methods utilised to assess clinical competency and fitness-to-practice in the final year clinical practicum subjects in an Australian osteopathy program. <i>Key points</i>

(continued on next page)

Table 4 (continued)

Author and ROB	Setting/Population	Design/Methodology	Key Findings/Results
Bright & Wasik, 2013 [65] Moderate ROB	UK: The European School of Osteopathy 44 patients within the ESO, seen by 27 final year students seen between July and August 2007 at the ESO clinic.	Cross sectional repeated measures Assess student osteopaths' subjective skills at recognising overweight patients, by comparing their assessment of body size with objective categorisation of obesity using both body mass index (BMI) and Body Fat Percentage (BFP).	A range of assessments are used in the final year of the osteopathy program to develop a comprehensive picture of a student's fitness-to-practice. Assessments should address the knowledge, skills and attributes required for graduate osteopathic practice. No one type of assessment can provide a determination of a student's fitness to practice. This study suggests that osteopathic undergraduates are poor at identifying patients with excess weight. There were inconsistencies between the student reported findings and those of the pre-examination setting. i.e. the BMI v BFP. Students reported 1 morbidly obese patient versus the clinical findings of 11 patients. Males had a greater tendency to be classed as overweight or obese for both readings and women tended to be normal to overweight. There was agreement between student categorisation and BMI for 55% of observations (n-24); the remaining 20 student assessments under-estimated the body size category compared with BMI. When student category was compared with BFP, there was agreement for only 20% of observations (n-9). The remaining 80% of student observations underestimated body category.
Fletcher, 2008 [66]	UK: Commentary Regarding, clinical	Narrative review/ commentary article.	This paper discusses clinical competence examination and

Table 4 (continued)

Author and ROB	Setting/Population	Design/Methodology	Key Findings/Results
Moderate ROB	competence assessments,		how to improve its validity and reliability. Suggested strategies are to: standardisation (or simulation) of the patient, e.g., using trained or primed patients. Ensure adequate examiner training. Observe the encounter and specify criteria for observation and assessment. Standardise the questions asked in the post-encounter interview. Increase the number of long cases contributing to a decision on a candidate. Keep a record of the long cases being allocated, linking this to the candidates' course content.
London, 2008 [67] Moderate ROB	UK: Commentary	Commentary regarding assessments in clinical settings	In the United Kingdom, assessment of clinical practice in medical education has proved to be a consistently difficult process. Central to these difficulties are issues surrounding the validity, reliability and feasibility of assessment of clinical practice that accurately reflect student abilities, whilst also representing real life examples of patient care. Osteopathic institutions within the UK have an educational, professional and ethical obligation to ensure that their assessment satisfies all these criteria. However, it is arguable that there is also a need to ensure that standards exist between schools so that all students graduating from different programmes are comparably assessed to a

(continued on next page)

Table 4 (continued)

Author and ROB	Setting/Population	Design/Methodology	Key Findings/Results
Abbey et al., 2014 [68] High ROB	Australia, Belgium, Canada, France, Germany, Italy, New Zealand, Russia and the UK: A convenience sample (n = 50) of OEI teaching staff, qualified osteopaths and students attending one of four conferences held in France, the Netherlands and the UK between September and November 2012.	Participants read an abstract from a hypothetical student project and sorted cards containing project extracts into unacceptable, acceptable or good examples of criticality and recorded scores on marking grids.	standard that may be valid and reliable. There were statistically significant differences in distribution between the four workshops: Group 3 recorded higher and Group 4 recorded lower scores than expected overall ($X^2 = 23.49$, $p = 0.001$). Group 4 also categorised more cards as “unacceptable” and fewer cards as “good” Within the whole group, there appeared to be weak to moderate agreement in the expected categories, except for cards two cards which had less than 50% agreement. There were lower levels of percentage agreement about “acceptable” levels of criticality (40–54%) compared with the lower and higher ends of the expected criticality range (70–94% and 58–76% respectively). Borderline cards were scored conservatively, towards the lower end of their range. Groups 1 & 4 demonstrated higher levels of agreement for cards with lower expected levels of criticality but there was less agreement about cards with higher expected criticality levels. For the whole data set, inter-rater agreement for the five card categories varied from $k = 0.01$ for G cards up to $k = 0.16$ for the AG cards, but all categories failed to achieve a kappa score of >0.20 , an indicator of “fair” agreement.
Vaughan & Florentine,	Australia, 2011; The results of OSCE	Retrospective Cohort: Data from	Twenty-six students failed at least one

Table 4 (continued)

Author and ROB	Setting/Population	Design/Methodology	Key Findings/Results
2013 [69] High ROB	of forty-eight final year osteopathy students were analysed at Victoria University.	the OSCE conducted in 2011 was collated and analysed to establish the pass/fail rates, cost of the examination, internal consistency, and variance components. The examination was conducted over two days with students completing 5 stations on day 1 and 4 stations on day 2. Each station was of 15 min duration and there were 2 examiners per station. Forty-eight students and 31 examiners were involved in the examination	station with six students failing three or more stations. Nine (19%) students failed one station, 11 (23%) failed two stations and 6 (12.5%) failed three or more stations. The average total scores awarded by the Lead Examiner and the Secondary Examiner were very similar for each station. Cronbach’s alpha was greater than 0.80 for all stations indicating that each is internally consistent and over 50% of the variance in the students total score for a station was due to the students themselves. The total cost of conducting the examination was AUD \$12,933.20.

literature discusses a range of assessment types, their properties and student performance, as well as alternative strategies for assessment.

Table 5 discusses curriculum content in osteopathy, of the 8 papers included 6 are commentaries discussing opinions regarding what should be taught. One paper is a content analysis, and one is a qualitative study regarding what role the osteopathic principles should hold in education. The main theme covered is osteopathic identity, including the principles, use of evidence and the tensions between evidence and principle-based practice. The ROB ranges from low, moderate, and high, however the only low ROB inclusions are commentary pieces which inherently represent a low level of evidence.

The evidence regarding the osteopathic curriculum is underdeveloped and based largely on opinion pieces (6/9). There is one content analysis of exercise content in the UK curriculum, between 2003 and 2004, and a qualitative study regarding the role of the OP. The evidence largely discusses future directions and the tensions between traditional and contemporary approaches and the influence of curriculum on professional identity, a theme which is present in much of the literature reviewed and across multiple categories.

The miscellaneous category was created to capture valuable information which did not integrate well with the other categories. The formulation of these categories is a construction of the authors, and each item may fit within multiple categories and alternative titles may be equally fitting. Within this category a range of studies are presented with differing methodologies and areas of enquiry. This includes reflective practice, use of poetry and clinical audit.

4. Critical interpretive synthesis

Results were categorised into five main topic areas: Teaching, Assessment, Curriculum, Clinical education and preparedness of practice and a Miscellaneous category to include papers which did not fit within the other classifications.

Table 5
Curriculum.

Author and ROB	Setting/ Population	Design/ Methodology	Key Findings/Results
Salmon et al., 2022 [70] Low ROB	France: Commentary	Commentary	This article aims to provide a reflection about the concept of Patient Centered Care within the French osteopathic education and the challenges associated with its deeper implementation. The authors state before modifying educational settings, osteopaths and researchers, especially in France, need to explore their thoughts and practices around PCC in clinical and educational contexts. The authors call for critical reflection regarding historical models of practice.
Vaughan, MacFarlane et al., 2014 [71] Low ROB	Australia. Commentary.	Commentary: This paper is an overview of clinical education in the osteopathy program at Victoria University Australia	Students undertake clinical education subjects throughout the 5 years of the program, gaining greater autonomy as they progress. Students may also complete clinical hours in a private practice placement. The Clinical Educators in the program are registered osteopaths with more than 3 years clinical experience. A range of competency assessments are used as well as reflective portfolios and formative assessments.
Blanchard, 2009 [72] Low ROB	UK: Commentary	Commentary. Osteopathic services within a HIV day care centre.	The paper is about setting up the clinic, secondary data is reported regarding educational aims. The primary educational objective of this specialist clinic is to increase participating students' depth and breadth of knowledge of HIV-infection, its impact and management in an applied setting. It is also seen as providing valuable opportunities for enhancing clinical skills by exposure to patients with complex needs, both physical and

Table 5 (continued)

Author and ROB	Setting/ Population	Design/ Methodology	Key Findings/Results
Blanchard, 2009 [73] Moderate ROB	UK: Nine qualified osteopaths involved in osteopathic education in the UK. 2012.1 participant <35 years of age 8 participants >35 years of age. 3 female 6 male. Years in clinical practice- Average: 15 Range: 3–26. All qualified as osteopaths with a BSc in osteopathy. 6 qualified at an OEI in the UK, 2 outside of the UK.	Qualitative Interpretive thematic analysis	psychosocial, in an environment with appropriate intensive support. This may lead to the development of improved patient management and communication skills within a multidisciplinary setting. Initial student feedback suggests that additional valuable learning opportunities do occur, and that enhancement of patient management skills is possible in this context. A range of views regarding osteopathic principles (OP). Some participants valued the historical imperative of OP in osteopathic curricula; others appreciated the foundation OP provide for understanding osteopathy. Some expressed personal disappointment in how they were educated about OP as students. Disappointing educational experiences fuelled suggestions for how OP should be taught. Participants stressed that osteopaths' opinions are largely shaped within the educational setting, by teachers. They argued therefore, that much thought should go into how OP is presented to students.
Zegarra-Parodi & Fabre, 2009 [74] Moderate ROB	France: Commentary	Commentary: Regarding teaching historical concepts of spinal motion	The authors propose that the teaching of Fryette's Laws is contradictory when compared with the current knowledge of biomechanics and can make the teacher lose credibility with their students (when they access the research about this subject).
Licciardone, 2008 [75] Moderate ROB.	Commentary	Commentary: Regarding the teaching of statistics and research concepts	The author states that undergraduate coursework in research methods and statistics is necessary to adequately prepare osteopathic students to become knowledgeable consumers of

(continued on next page)

Table 5 (continued)

Author and ROB	Setting/ Population	Design/ Methodology	Key Findings/Results
Zamani et al., 2007 [76] Moderate ROB	UK: Content analysis of exercise curricula in 7 of 8 UK osteopathy schools between 2003 and-2004	Content analysis	biomedical literature. Such curricula should focus on evidence-based applications relevant to diagnosis and therapy. Exercise content was variable in quantity and quality. Six of the curricula explored exercise content relating to movement, the theoretical principles of exercise and individualised or measurable responses to undertaking exercise or physical activity e.g. sports injuries. Clear links between osteopathic treatment and sport in general, sports injuries and the management of athletes were made. Only one school included explicit exercise content in the context of wider health education and promotion.
Sposato et al., 2018 [77] High ROB	Europe: Commentary	Commentary: Addressing the ongoing friction between anecdotal and evidence-based teachings in osteopathic education in Europe	The author describes a tension between anecdotal and evidence-based teaching in osteopathy. They suggest that osteopathic academic institutions aim to provide students with an education that promotes autonomous and reflective practice. They argue a general increase in academic levels among osteopathic educators will ease the friction between anecdotal and evidence-based teaching.
Sommerfeld, 2008 [78] High ROB	Commentary	Commentary with Foucauldian and Derridean lenses used to discuss values and normative claims within osteopathy.	This paper discusses what values should be taught and how this influences the view of the profession: The patient can be identified as the goal of the teaching subjects' responsibilities as it is the patient who enables the existence of the profession itself. There is no generally agreed strategy for teachers of osteopathy to help them manage the situation. An ongoing

Table 5 (continued)

Author and ROB	Setting/ Population	Design/ Methodology	Key Findings/Results
			process of deconstructive self-reflective alertness that prevents the teaching person from excesses of either orthodox ideology or opportunistic relativism is recommended.

Osteopathic Educational Research (OER) appears to be a relatively new area of enquiry, with a slowly developing evidence base. The earliest retrieved record is from 2002. It appears that the majority of OER is produced within a handful of institutions and with some researchers, and research teams, contributing extensively to the evidence base. Whilst there was a wide geographical range captured in this review, the majority of publications are from Australia, the UK or France. The evidence is heterogeneous and although largely deemed low risk of bias, it is inherently low on the hierarchy of evidence based on the methodologies used. This includes opinion papers, qualitative studies and cross-sectional surveys. We did not identify any methodologically robust experimental evidence regarding osteopathic education or long-term observational studies.

The evidence regarding what should be taught and how is a much-discussed area, with little empirical investigation. Discourses regarding the place for evidence-based practice, research, criticality, and traditional ways of being and learning osteopathy; such as palpation and osteopathic principles, echo the evidence from the wider profession. There is a lack of consensus regarding what should be taught and how, which is consistent with the lack of an agreed definition of osteopathy and the range of views regarding professional identity which are held within osteopathy.

Evidence based teaching is an area of interest. The literature discusses student perceptions of learning and what makes a good osteopathic educator; students generally hold a positive view of the educational environment. Students value self-directed learning and active approaches using a range of techniques and channels of communication, such as visual and kinaesthetic learning. Online and electronic learning is an emergent area of research and has been demonstrated to be an effective addition to core educational strategies in osteopathy. Much of the literature discusses acquiring palpatory skills, although the findings regarding the teaching of these skills are equivocal.

Assessment in osteopathic education is challenging as assessments need to be valid, reliable and are limited by pragmatic concerns of cost effectiveness and staffing levels. Assessment in early years may be formative and contain assessment for learning, however, in graduating years, clinical competence must be displayed. This is traditionally assessed via formal practical assessments. Alternative assessment strategies have been investigated, such as continued tutor assessment but these may be less robust. There is a tension between educators both delivering instruction and assessing learners which may impact both learning and assessment.

A particular challenge to the osteopathic profession is the lack of consensus regarding a set minimum standard of knowledge and competence which needs to be achieved to confer the title osteopath, therefore osteopathic teaching and assessment is heterogeneous and challenging to define.

5. Discussion

This review sought to chart and appraise the evidence regarding

Table 6
Miscellaneous.

Author and ROB	Setting/Population	Design/Methodology	Key Findings/Results
Marettic & Abbey, 2021 [79] Low ROB	UK: Eleven semi-structured interviews were conducted with educators from one institution (UCO ₂ UK), with a self-reported interest in PCC and/or Medical Humanities (MH) and Narrative Medicine (NM). Eight were males and three females. Participants experience in clinical practice ranged between two and thirty-one years, and osteopathic educational experience between one and thirty years.	Qualitative semi-structured interviews. Using elements of grounded theory.	Participants expressed varied views about the utility of poetry and pedagogical techniques for integrating it. Poems were considered to facilitate better understanding of patient's life contexts by exploring the use of metaphorical language and employing techniques such as classroom interpretations and meaning co-construction, role-playing, perspective-taking and reflective writing to generate deeper awareness. Medical Humanities poetry could be a potentially valuable teaching tool to increase students understanding of patients and to help them ground their practice within a constructivist epistemology where value is placed on the relationship between patient and practitioner.
McLeod et al., 2020 [80] Low ROB	Australia: Year 4 & 5 Osteopathic students at Southern Cross University, 2016.	Cross sectional survey: Regarding reflective practice.	Those participants who had completed a postgraduate qualification were more likely to use reflection frequently ($p = 0.019$, $r = .47$) and to use reflection after an osteopathic consultation ($p = 0.029$, $r = .44$) compared with those with an undergraduate qualification. Most students indicated that reflection served multiple purposes, with close to 90% ($n = 29$) using the reflective tools to ex-amine and increase their level of learning, more than half (68.7%, $n = 22$) agreed that CR helped them to understand individual values and assumptions,

Table 6 (continued)

Author and ROB	Setting/Population	Design/Methodology	Key Findings/Results
			and 87.5% ($n = 28$) believed that CR helped to develop self-awareness. Although just over half the students ($n = 19$, 59.4%) reported feeling that the level of focus on RP in the osteopathy course was sufficient, the remainder would like to see a greater focus given to RP. <i>Themes identified:</i> Reflective practice is a process of deliberate critical appraisal of self within a clinical context. Reflective practice is important and a valued aspect of osteopathy education. Students require additional dedicated time and support to develop reflective practice. This concept paper signposts the potential vulnerability of the patient and the student if supervision standards are not maintained and if appropriate clinical standards are not applied. Possible lines of arguments a patient may raise, or a student may raise in a negligence case as well as possible defences the clinical educator may offer are presented.
Moore, 2020 [81] Low ROB	Commentary	Thought experiment In Australian context based on a hypothetical scenario.	Intermediate level practitioners demonstrate significantly more analytical decision-making than their novice peers ($p = 0.007$; effect size 0.31); however, reflective thinking dispositions do not change as participants progress through their training ($p = 0.07$). No significant association was found between analytical decision-making and reflective thinking ($p = 0.85$).
Spadaccini & Esteves, 2014 [82] Low ROB	UK osteopathy students at the start (novice $N = 44$) and end (intermediate $N = 32$) of their pre-professional training	A quasi-experimental design using the Cognitive Reflection Test (CRT) to measure decision-making preferences and the 41-item Actively Open-minded Thinking disposition scale (AOT)	

(continued on next page)

Table 6 (continued)

Author and ROB	Setting/Population	Design/Methodology	Key Findings/Results
Brunt & Abbey, 2014 [83] Low ROB	UK: BSO Clinic. 3rd and 4th year students.	Clinical audit A drug Handbook and the Quick Reference guide were created as well as a 1-hour lecture on medication and an overview of the new drugs reference material and defining the new benchmark for medication recording. Also covered mechanisms of drug action, and drugs considered especially clinically relevant to osteopaths.	The small increase in number of medications recorded per history in the 1st round (2.14) to the 2nd round (2.53) was statistically significant (U = 4043.00, p = 0.01). The assessment criteria recorded most accurately in both audits were medication named, indication for use and measurement units. The least accurately recorded measures were strength and frequency of use. In accordance with the a priori standard, the data was separated into 2 groups of less than 75% and more than or equal to 75% accurate recording. A Chi Squared test showed that the 12% increase in the more than 75% accurate group in the 2nd audit was just statistically significant (X ² = 3.84, df = 1, p = 0.050). No significant differences were observed in the 1st audit but in the 2nd audit, 4th year students were more accurate in naming medications, recording strength and average accuracy.
Moore, 2020 [84] Moderate ROB	Australia: Seventeen educators associated with seven Australian universities. The participants included: Chiropractic (n = 4); Exercise Physiology (n = 1); Osteopathy (n = 9); Podiatry (n = 1) and Speech Pathology (n = 2).	Thematic content analysis. This qualitative study using document analysis and a purpose-built online survey distributed among allied health clinical educators.	Most participants were aware they owed a duty to the patient; less that they owe a duty to the student, and many do not understand the elements of legal disputes of negligence. Not all understood poor standards of record-keeping and a lack of documentation of students' progress may be issues of legal debate in negligence cases.
Palfreyman et al., 2018 [85] Moderate	New Zealand: A total of 68 student records were analysed for the first part of the	Mixed methods study explored the relationship between pre-admission	Previous study of Biology conferred a moderate advantage in terms of success in the first semester,

Table 6 (continued)

Author and ROB	Setting/Population	Design/Methodology	Key Findings/Results
Wallace, 2008 [86] Moderate ROB	study in New Zealand, including student cohorts from 2012 to 2014. There were 21 male and 47 female students, with ages ranged from 18 to 52 (mean age 25, SD 8.56). A large majority of the students were of "European ethnicity" (75%; n = 51), with only small numbers of Māori (2.9%; n = 2), Pacifica (7.4%; n = 5), Asian (4.4%; n = 3) or "Other ethnicities" (10.3%; n = 7).	academic qualifications and subsequent performance in an osteopathic education programme in New Zealand.	but there was no significant correlation at the end of the first year. Other sciences did not appear to confer a benefit on performance in the programme. Participants' experiences supported this finding. Confidence in at least one aspect of their studies was identified by participants as being important: this confidence could stem from prior science studies, transferable skills from other studies, or more abstract factors such as interpersonal skills. The highest level of achievement in any single subject showed a medium correlation with the mean first semester GPA (r squared 0.352, p < 0.05), suggesting that approximately 12% of the variation in mean GPA was predictable from the highest level of study achieved (as determined by the coefficient of determination, R squared). Correlation between the highest level of Biology studied (r squared 0.298, p < 0.05) and the mean GPA over the first semester, suggesting that approximately 9% of the variation in mean GPA was predictable from the level of Biology studied. There was no significant correlation found for the other subjects considered. Qualitative interviews with thematic analysis were used to construct three themes: knowledge, skills and personal qualities. This paper describes osteopathic education and the attributes of a good teacher.

(continued on next page)

Table 6 (continued)

Author and ROB	Setting/Population	Design/Methodology	Key Findings/Results
Macfarlane & Cornall, 2019 [87] High ROB	Australia: Post graduate osteopathy course with 13 Australian osteopaths.	Qualitative Thematic analysis: Results were presented at a focus group type workshop on the post-graduate course. Research questions were: What is the most important advice you could give to participants about using OCF in their practices? What strategies will you use to implement your new skills from this course into your practice?	teacher. The author argues that there is an expectation that, in addition to being a competent osteopathic practitioner, the osteopathic teacher must demonstrate professional and educational expertise, together with a self-awareness of their personal limitation. The results consist of six categories: Building Trust & Confidence, Developing Support Networks, Choice of Tools, Patient Selection, Managing Time and Learning AT Stillness (Meaning nebulous concepts such as intangible and intuitive reasoning), a single overarching theme entitled "Expanding option".
Nascimento et al., 2016 [88] High ROB	Brazil Twenty-two (22) physical therapists with an undergraduate education and seventeen (17) physical therapists with postgraduate school education in osteopathy.	Cross sectional: A haptic test consisting in the tactile recognition of two geometric figures. The accuracy of figurer production, time of figure exploration and students' perception of task difficult were scored.	Both groups of physical therapists showed high accuracy in the reproduction of the easier figure (task 1) with accuracy percentages above 90%. While reproduction of the more difficult figure (task 2) presented accuracy scores between 42% and 62%. The time needed to reproduce the figure for task 2 was approximately triple that of the figure for task 1. Task 1 was perceived as easier than task 2 by both groups. Statistically significant differences were only found for task 2 (p = 0.243 for task 1; p = 0.015 for task 2). In task 1, postgraduate school-trained physical therapists needed less time to reproduce the figure (Mann Whitney U =

Table 6 (continued)

Author and ROB	Setting/Population	Design/Methodology	Key Findings/Results
			119.0, p = 0.43) and rated the task difficulty with significantly lower scores (Mann Whitney U = 105.0, p = 0.06) than non-graduate school physical therapists. No significant differences in time or task difficulty were found in task 2.

osteopathic education. It is the first review to do so and followed a robust methodology with an expansive search, resulting in a substantial number of included publications.

Elements of the literature which demonstrate good educational practice have been identified as areas for potential development in the wider osteopathic educational practice community. These areas for development also align with our recommendations for further research.

The evidence regarding curriculum or what should be taught is underdeveloped and is clearly reminiscent of the truculent discourse regarding osteopathic identity [89], the role of the principles, the use of the evidence-base and the future of the profession. It is unsurprising that there is dispute regarding osteopathic education and what the syllabus should contain when we consider that there is no clear consensus regarding the definitions of osteopathy or what the practice of osteopathy entails. Benchmarking statements regarding osteopathic education [1,4] have been published, yet not universally adopted or implemented. This has led to a wide range of standards and practices in osteopathy internationally [90]. This was a theme also present in the literature when discussing students views of preparedness for practice.

Palpation was identified as a prominent area in the literature and despite limited validity and reliability of palpation [91], it is still a requirement of some regulatory standards [92]. This review indicated there may not be differences between novice and experienced practitioners, therefore, devoting extensive teaching time and scarce resources to acquiring palpation skills may be inefficient. Palpation is, however, a core element of some osteopaths' professional identity. There may be intangible benefits to learners; such as a sense of community and uniformity of training in palpation, amongst the osteopathic community, as well as palpation being an element of a therapeutic encounter and facilitating communication [93].

Surprisingly, there was not a great deal of literature concerned with the teaching of specific manual therapy skills, such as spinal manipulation or other treatment modalities. Although the relevance of additional instruction in these techniques may be of limited practical value [94], as with palpation, it is a tacit element of professional osteopathic identity and shared professional socialisation [89].

The challenges of assessment are not unique to osteopathy; particularly in 'high stakes' examinations, such as final clinical competence exams. There is a tension between credentialing and learning [95]. Assessment of learning and meeting standards of competence are necessities of registration to practice, which may not be an ideal strategy to drive learning but is suitable for ensuring standards are attained [96]. Assessment for learning with formative feedback can be appropriate to plan students' learning and ideally should incorporate reflective elements. This is more appropriate in earlier stages of the course and learner development [97,98].

The dual role of learners as healthcare professionals and students was highlighted as problematic, particularly when this may create a conflict between learning needs and patient care. Learners are also often

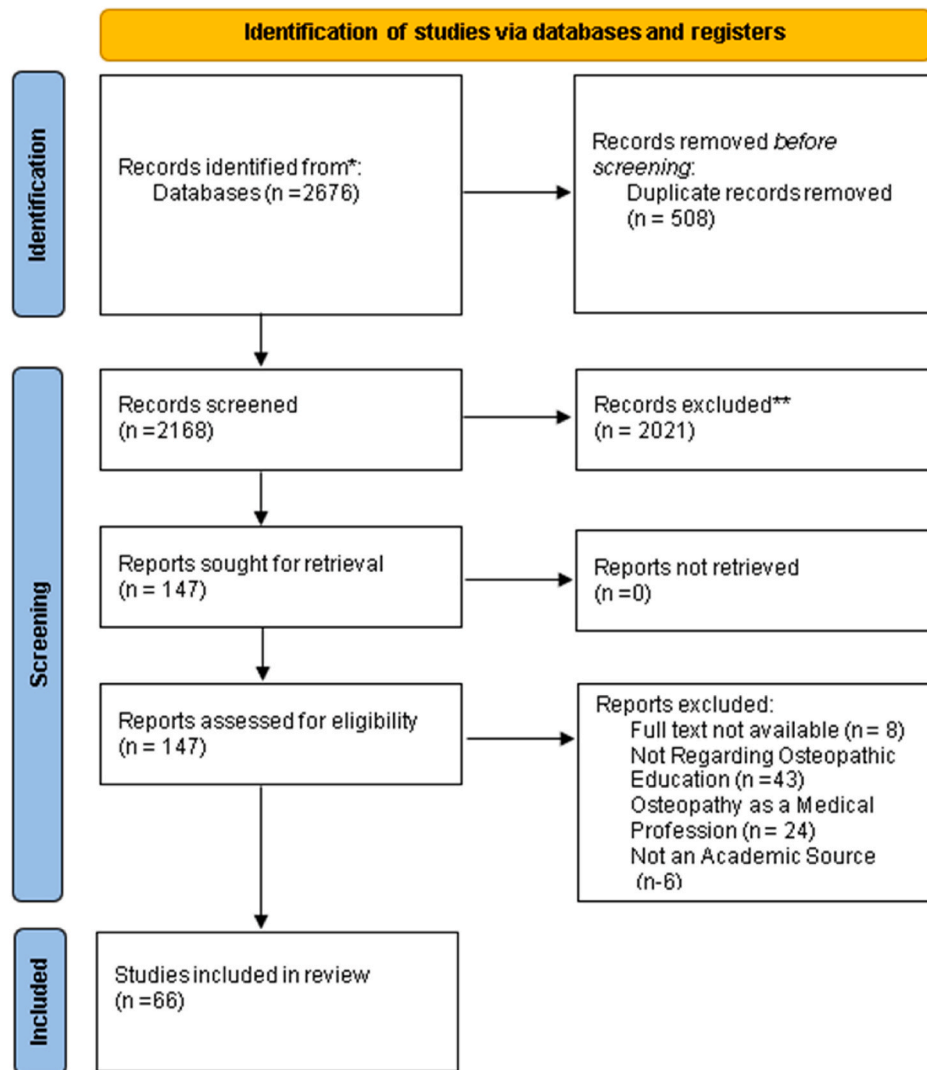


Fig. 1. Prisma flow chart [23].

assessed by clinical tutors, with whom they may have worked closely or may continue to work with in future. This highlights a difficulty for both educators and students in terms of personal relationships and objective assessment. Students may mask difficulties to avoid highlighting an area they have not yet mastered which is detrimental to learning in an attempt to improve summative marks. The assessment strategies may promote surface learning and strategic study of assessed material rather than developing deep learning and understanding of the material [96]. Strategies to address this in the osteopathic literature include longer case assessments, continuous assessment periods and portfolio assessments. However, these may be cost prohibitive and a balance between utility and robustness must be found [99].

Competency based assessment rather than assessment of pure knowledge may ameliorate some of the challenges seen in osteopathic education, were there to be an established and agreed set of core osteopathic competencies. This would aid in creation of an agreed curriculum framework and methods of assessment [100]. These issues would logically precede the ways in which education is delivered, with a clear outcome at the end of a programme of training facilitating the course design, delivery, and constructive alignment.

A lack of congruency between academic and clinical delivery was highlighted in this review. Furthermore, students' preferred self-directed and active learning strategies, which may facilitate deeper learning [101]. Online learning and electronic resources were seen as an

important addition to conventional delivery and in some instances an alternative to formal in-person instruction. This may be a cost effective and flexible method for teaching and has been trialled extensively within the wider educational context which should be developed within osteopathic education. The development and adoption of these approaches predates, but has been necessitated and hastened by, the Covid-19 pandemic [102]. The use of these technologies is welcomed by educators and learners but may also have barriers to implementation [103] and may impact the sociocultural elements of pedagogy, including the hidden curriculum in osteopathy such as palpation or technique [71]. There is no available evidence in osteopathy regarding the impact of these strategies on future performance or readiness for practice. Therefore, we are reticent to recommend the implementation of these strategies, until stronger evidence is available.

6. Challenges

Student perception of the learning environment was positive overall, yet there were strong themes of dissatisfaction within the literature with students suggesting ways in which delivery or assessment should be conducted. Student satisfaction may be used as a proxy marker for quality in education and is a goal of OEIs in a competitive marketplace. However, it is a poor predictor of learning or teaching quality [104]. Many factors may influence students' perception, including personal

Publication date	Number of Articles
2002	1
2007	1
2008	7
2009	3
2010	2
2012	1
2013	4
2014	11
2015	3
2016	2
2017	7
2018	6
2019	4
2020	6
2021	7
2022	1
Total	66

Fig. 2. Publication dates of the included articles.

characteristics of educators [105], student performance, or timing of feedback surveys. It has been argued that many measures of student satisfaction lack face validity [106]. However, measuring student

experience and outcomes, to enhance quality of delivery and attainment remains a priority for educational institutions, despite the known limitations of survey data to accurately reflect learning quality or the educational environment.

7. Limitations

This review is the first to chart the evidence regarding education in an osteopathic context and followed the best available guidance [9,12,22]. With no language or date limitations placed upon the search, language limitations were part of our exclusion criteria although were not needed and so did not constrain the results.

This review excluded osteopathy as a medical profession due to the heterogeneity in the way these types of osteopathy are practiced and taught [2]. However, this will have unavoidably led to the exclusion of research which focused on teaching of concepts which are applicable to osteopathy within this review’s context. This was deemed justifiable as data from other medical, allied and complementary health professions and wider pedagogy were also excluded yet may have informed osteopathic educational delivery.

There were no date limitations placed on this review and eight (N = 8) papers were not available in an electronic format or retrievable by the research team contacting the journals and listed correspondence author. The impact of this upon the review is not known, although due to the age of the papers and ample availability of contemporary literature we do not consider it to have critically compromised the quality and veracity of this review. It is possible that this limited the historical contextualisation of this review and ability to contrast the changes within osteopathic education. However, this will not necessarily impact our findings regarding contemporary praxis, research priorities or recommendations.

Due to the high yield of included peer reviewed sources, the decision was taken after title and abstract screening to exclude grey literature. This may have led to publication bias entering the review. However, the high yield retrieved necessitated prioritising higher levels of evidence within this review. The high yield of returns had substantial heterogeneity of methodologies, quality and results therefore synthesis and summary were challenging.

It is also noted that osteopathic education is not separate from wider pedagogy and many strategies and conventions in the wider literature may inform osteopathic education, which were not sought or summarised within this review. The high yield of returns had substantial heterogeneity of methodologies, quality and results therefore synthesis and

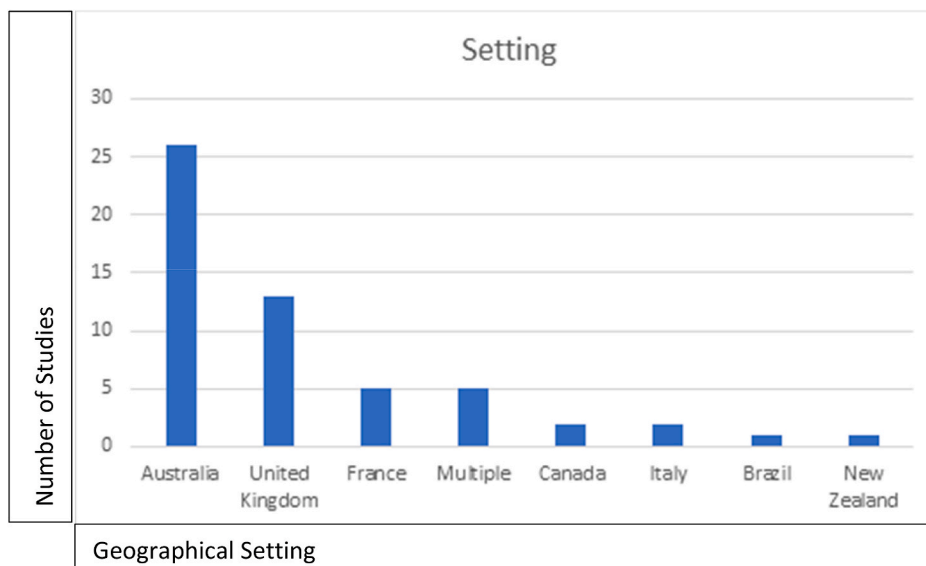


Fig. 3. Setting.

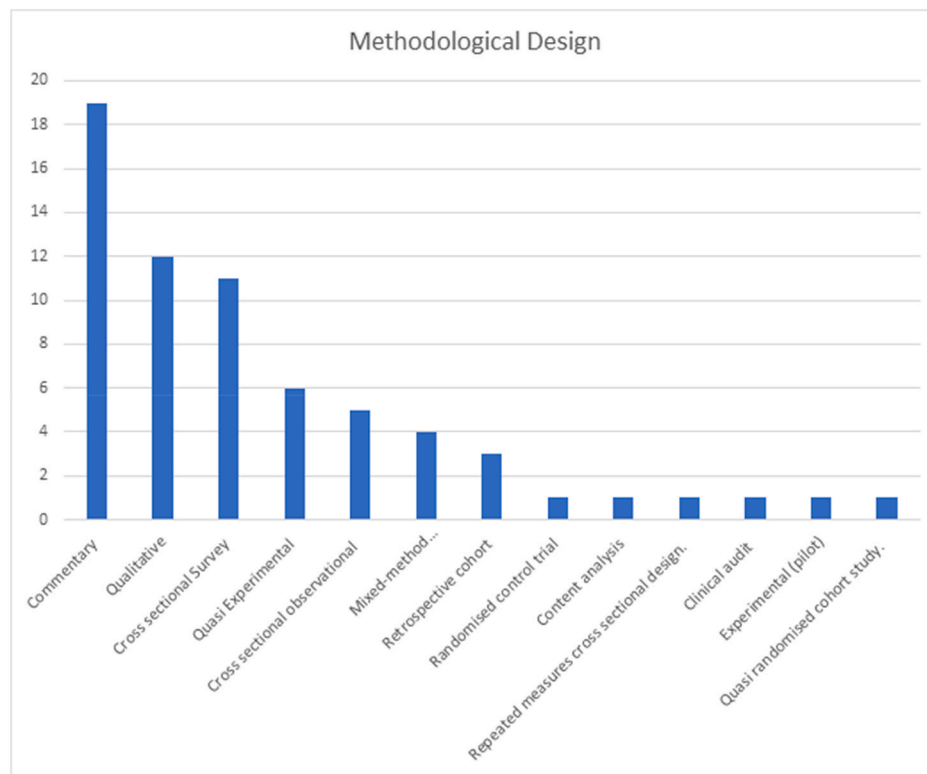


Fig. 4. Methodological design.

summary were challenging. It is also noted that osteopathic education is not separate from wider pedagogy and many strategies and conventions in the wider literature may inform osteopathic education, which were not sought or summarised within this review.

8. Recommendations based upon this review

8.1. Recommendations for teaching and assessment

Active learning was an area highlighted as preferred by learners as was self-directed study. This should be guided in earlier years and have greater independence as learners become more autonomous and join the community of practice. This may also integrate more practical learning aids and electronic or online learning. The evidence however is unclear regarding the impact of student preference on attainment and further research is needed before this strategy is widely adopted.

Competency-based assessment designed with a pragmatic approach to cost effectiveness may reduce the identified tensions between clinical assessment for and of learning. This should be supported by formative assessment and developed within an agreed set of core osteopathic competencies.

8.2. Future research priorities

The overall level of evidence is low: it would be beneficial to conduct further quantitative research regarding outcomes of differing educational interventions. As the evidence is emergent, and due to pragmatic limitations, this may not necessitate experimental designs. Observational and retrospective designs may be an appropriate first step.

The evidence regarding what is taught is underdeveloped and enhancing consensus regarding benchmarking of osteopathic education and minimum competencies is needed.

There is heterogeneity in the ways in which osteopathic learners are assessed and the validity of these assessments for predicting and ensuring quality in practice. Therefore, this is a key educational research

priority and is linked to the core competencies which need to be identified.

Preparedness for practice was a theme in the literature and further study with practicing osteopaths, employers and regulators may be warranted.

A significant gap in the literature remains regarding the experiences of and support for learners from marginalised or underrepresented communities.

9. Conclusion

This was the first review of osteopathic education and was conducted with no restrictions of location, language or date. This produced a large volume of results which have been summarised into five categories and narratively synthesised. The evidence base is heterogeneous but developing and future research priorities have been identified.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper. The authors are all osteopathic educators or researchers within a UK osteopathic educational institution. This research was in part funded by a grant for Enhancing Research Culture from UK Research and Innovation, which was used to develop the research capabilities of osteopathic educators.

Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.ijosm.2023.100663>.

References

- [1] WHO: benchmarking statement osteopathy. <https://www.osteopathy.org.uk/news-and-resources/document-library/research-and-surveys/who-benchmarks-for-training-in-osteopathy/>.
- [2] McGrath MC. A global view of osteopathic practice – mirror or echo chamber? *Int J Osteopath Med* 2015 Jun;18(2):130–40.
- [3] Newland A, Edwards C, Roland M. The role of osteopaths as allied health professionals within the national health service. 2020.
- [4] QAA. Subject benchmark statement osteopathy. <https://www.osteopathy.org.uk/news-and-resources/document-library/about-the-gosc/qaa-subject-benchmark-statement-osteopathy-2015/>. 2015.
- [5] Tricco AC, Lillie E, Zarin W, O'Brien KK, Colquhoun H, Levac D, et al. PRISMA extension for scoping reviews (PRISMA-ScR): checklist and explanation, vol. 169. *Annals of Internal Medicine*; 2018.
- [6] Arksey H, O'Malley L. Scoping studies: towards a methodological framework. *Int J Soc Res Methodol* 2005 Feb;8(1):19–32.
- [7] MacMillan A, Corser A, Clark Z. Inclusivity and accessibility in undergraduate osteopathic education for students with disability: a scoping review. *Int J Osteopath Med* 2021;40.
- [8] Peters MD, Godfrey CM, Khalil H, McInerney P, Parker D, Soares CB. Guidance for conducting systematic scoping reviews [Internet]. 2015 [cited 2022 Jun 15]. pp. 144–6. Available from: https://journals.lww.com/ijebh/FullText/2015/09000/Guidance_for_conducting_systematic_scoping_reviews.5.aspx.
- [9] Jahan N, Naveed S, Zeshan M, Tahir M.A. How to conduct a systematic review: a narrative literature review. *Cureus* 2016.
- [10] Zapf A, Castell S, Morawietz L, Karch A. Measuring inter-rater reliability for nominal data - which coefficients and confidence intervals are appropriate? *BMC Med Res Methodol* 2016;16(1).
- [11] Buscemi N, Hartling L, Vandermeer B, Tjosvold L, Klassen TP. Single data extraction generated more errors than double data extraction in systematic reviews. *J Clin Epidemiol* 2006;59(7).
- [12] Büchter RB, Weise A, Pieper D. Development, testing and use of data extraction forms in systematic reviews: a review of methodological guidance. *BMC Med Res Methodol* 2020;20(1).
- [13] Ma LL, Wang YY, Yang ZH, Huang D, Weng H, Zeng XT. Methodological quality (risk of bias) assessment tools for primary and secondary medical studies: what are they and which is better?, vol. 7. *Military Medical Research*; 2020.
- [14] Shea BJ, Reeves BC, Wells G, Thuku M, Hamel C, Moran J, et al. Amstar 2: a critical appraisal tool for systematic reviews that include randomised or non-randomised studies of healthcare interventions, or both. *BMJ (Online)*. 2017;358.
- [15] Joanna Briggs Institute. Critical appraisal checklists. <https://jbi.global/critical-appraisal-tools>. 2022.
- [16] Scotland J. Exploring the philosophical underpinnings of research: relating ontology and epistemology to the methodology and methods of the scientific, interpretive, and critical research paradigms. *Engl Lang Teach* 2012;5(9).
- [17] Pope C, Mays N. Qualitative Research: reaching the parts other methods cannot reach: an introduction to qualitative methods in health and health services research. *BMJ* 1995;(6996):311.
- [18] Sheldon NA, Lincoln YS, Guba EG. Naturalistic enquiry. *The Statistician* 1986;35(3).
- [19] Peters MDJ, Godfrey C, McInerney P, Munn Z, Tricco A, Khalil H. Chapter 11: scoping reviews (2020 version). In: Aromataris E, Munn Z, editors. *JBI manual for evidence synthesis*; 2020.
- [20] Munn Z, Peters MDJ, Stern C, Tufanaru C, McArthur A, Aromataris E. Systematic review or scoping review? Guidance for authors when choosing between a systematic or scoping review approach. *BMC Med Res Methodol* 2018;18(1).
- [21] Dixon-Woods M, Cavers D, Agarwal S, Annandale E, Arthur A, Harvey J, et al. Conducting a critical interpretive synthesis of the literature on access to healthcare by vulnerable groups, vol. 6. *BMC Medical Research Methodology*; 2006.
- [22] Draper-Rodi J, Vaucher P, Hohenschurz-Schmidt D, Morin C, Thomson OP. 4 M's to make sense of evidence – avoiding the propagation of mistakes, misinterpretation, misrepresentation and misinformation. *Int J Osteopath Med* 2022 Apr.
- [23] Page MJ, McKenzie JE, Bossuyt PM, Boutron I, Hoffmann TC, Mulrow CD, et al. The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. *BMJ* 2021 Mar 29;n71.
- [24] Aubin A, Boulanger C, Gagnon K, Morin C. The development and application of a remediation process in an osteopathic curriculum. *Int J Osteopath Med* 2021 Jun;40:46–53.
- [25] Fitzgerald KM, Denning T, Vaughan BR, Fleischmann MJ, Jolly BC. Simulation can offer a sustainable contribution to clinical education in osteopathy. *Chiropr Man Ther* 2019 Dec 10;27(1):38.
- [26] Fitzgerald K, Fleischmann M, Vaughan B, de Waal K, Slater S, Harbis J. Changes in pain knowledge, attitudes and beliefs of osteopathy students after completing a clinically focused pain education module. *Chiropr Man Ther* 2018;26(1).
- [27] Moore K, Field BJ. Enhancing clinical education in the private practice setting: a case study in osteopathy. *Int J Osteopath Med* 2017 Mar;23:42–50.
- [28] Vaughan B, Moore K, Kleinbaum A. Near-peer teaching in osteopathy clinical education. *Int J Osteopath Med* 2017 Sep;25:42–5.
- [29] Browne F, Rolfe K, Currie A, Walker T, Roff S. Adapting and feasibility testing pre-registration e-learning resources for Professionalism in Osteopathy in the UK. *Int J Osteopath Med* 2015 Mar;18(1):50–62.
- [30] Fitzgerald K, Denning T, Vaughan B. Simulated learning activities as part replacement of clinical placements in osteopathy: a case study. *Int J Osteopath Med* 2017 Dec;26:44–8.
- [31] Aubin A, Gagnon K, Morin C. The seven-step palpation method: a proposal to improve palpation skills. *Int J Osteopath Med* 2014 Mar;17(1):66–72.
- [32] Esteves JE, Spence C. Developing competence in diagnostic palpation: perspectives from neuroscience and education. *Int J Osteopath Med* 2014 Mar;17(1):52–60.
- [33] Fryer G. Teaching critical thinking in osteopathy - integrating craft knowledge and evidence-informed approaches. *Int J Osteopath Med* 2008;11.
- [34] Launay F, Ménard M, Bourgin M, Mhadhbi H, Sutre F, Draper-Rodi J. Impact of different types of revision materials on the learning of musculoskeletal techniques. *Int J Osteopath Med* 2021 Mar;39:47–53.
- [35] Diaz CM, Woolley T. Learning by doing": a mixed-methods study to identify why body painting can be a powerful approach for teaching surface anatomy to health science students. *Med Sci Educ* 2021 Dec 9;31(6):1875–87.
- [36] Tripodi N, Kelly K, Husaric M, Wospil R, Fleischmann M, Johnston S, et al. The impact of three-dimensional printed anatomical models on first-year student engagement in a block mode delivery. *Anat Sci Educ* 2020 Nov 16;13(6):769–77.
- [37] D'Alessandro G, Consorti G, Cerritelli F. Self-directed learning and practice of Italian osteopathic students during summer break: a cross-sectional survey. *BMC Compl Alternative Med* 2019 Dec 6;19(1):201.
- [38] Tripodi N. First-year osteopathic students' use and perceptions of complementary video-based learning. *Int J Osteopath Med* 2018 Dec;30:35–43.
- [39] Browning S. An investigation into the current practices and educational theories that underpin the teaching of palpation in osteopathic education: a Delphi study. *Int J Osteopath Med* 2014 Mar;17(1):5–11.
- [40] Lalonde F. Problem-based learning in osteopathic education. *Int J Osteopath Med* 2013 Dec;16(4):216–9.
- [41] Wong D. Active learning in osteopathic education: evaluation of think-pair-share in an undergraduate pathology unit. *Int J Osteopath Med* 2022 Mar;43:63–70.
- [42] Lavazza C, Milano V, Abenavoli A, Maggiani A. How type and number of training sessions influence the reliability of palpation. *J Bodyw Mov Ther* 2018 Apr;22(2):396–401.
- [43] Zegarra-Parodi R, de Chauvigny de Blot P, Rickards LD, Renard EO. Cranial palpation pressures used by osteopathy students: effects of standardized protocol training. *J Am Osteopath Assoc* 2009;109(2).
- [44] Vaughan B. Clinical educator self-efficacy, self-evaluation and its relationship with student evaluations of clinical teaching. *BMC Med Educ* 2020 Dec 7;20(1):347.
- [45] Vaughan B, Grace S, Gray B, Kleinbaum A. Engaging with evidence-based practice in the osteopathy clinical learning environment: a mixed methods pilot study. *Int J Osteopath Med* 2019 Sep;33(34):52–8.
- [46] Clarkson HJ, Thomson OP. 'Sometimes I don't feel like an osteopath at all' - a qualitative study of final year osteopathy students' professional identities. *Int J Osteopath Med* 2017 Dec;26:18–27.
- [47] Vaughan B, Macfarlane C. Perceived teaching quality between near-peer and academic tutors in an osteopathic practical skills class. *Int J Osteopath Med* 2015 Sep;18(3):219–29.
- [48] Luciani E, Cerritelli F, Waters M, Zegarra-Parodi R. Osteopathic student satisfaction and preparedness to practice: a comparative study. *Int J Osteopath Med* 2014 Mar;17(1):28–37.
- [49] Vaughan B, Carter A, Macfarlane C, Morrison T. The DREEM, part 1: measurement of the educational environment in an osteopathy teaching program. *BMC Med Educ* 2014 Dec 20;14(1):99.
- [50] Johnston S, Vaughan B. 'We need one more hour solely based on anatomy... Give us anatomy!': early-year learner perceptions of anatomy within an integrated & case-based learning osteopathy curriculum. *Int J Osteopath Med* 2020 Jun;36:49–54.
- [51] Quesnay P, Poumay M, Gagnayre R. How does French initial osteopathic training value relational competency, patient education, and the competency-based approach? A cross-sectional survey. *Int J Osteopath Med* 2021 Dec;42:43–50.
- [52] Haworth NG, Horstmanshof L, Moore KM. Chiropractic and osteopathic students' perceptions of readiness for transition to practice: *The educational value of university clinic vs community and private clinics*. *J Chiropr Educ* 2021 Mar 1;35(1):38–49.
- [53] Hartup JK, Murphy RA, Plowman LM, Myers R. Progression through osteopathic training in Australia: the student experience. *Int J Osteopath Med* 2010 Dec;13(4):160–5.
- [54] Robertson A, Gibbons P, Carter A. Student and patient perspectives on the interaction between supervisors, students and patients during the clinical teaching experience at a university out-patient clinic: a descriptive pilot study. *J Osteopath Med* 2002 Apr;5(1):8–15.
- [55] Vaughan B, Florentine P, Carter A. Introducing a portfolio assessment in a pre-professional osteopathy program. *Int J Osteopath Med* 2014 Jun;17(2):129–34.
- [56] Moore K, Grace S, Orrock P, Coutts R, Blaich R, Vaughan B. Benchmarking the strategies for assessing clinical reasoning in osteopathic curricula. *Int J Osteopath Med* 2014 Sep;17(3):187–98.
- [57] Esteves JE, Bennison M, Thomson OP. Script concordance test: insights from the literature and early stages of its implementation in osteopathy. *Int J Osteopath Med* 2013 Dec;16(4):231–9.
- [58] Vaughan B, Sullivan V, Gosling C, McLaughlin P, Fryer G, Wolff M, et al. Methods of assessment used by osteopathic educational institutions. *Int J Osteopath Med* 2012 Dec;15(4):134–51.

- [59] Abbey H. Assessing clinical competence in osteopathic education: analysis of outcomes of different assessment strategies at the British School of Osteopathy. *Int J Osteopath Med* 2008 Dec;11(4):125–31.
- [60] Fitzgerald K, Vaughan B. Learning through multiple lenses: analysis of self, peer, nearpeer, and faculty assessments of a clinical history-taking task in Australia. *J Educ Eval Health Prof* 2018 Sep 18;15:22.
- [61] Vaughan B, Orrock P, Grace S. Reliability of a viva assessment of clinical reasoning in an Australian pre-professional osteopathy program assessed using generalizability theory. *J Educ Eval Health Prof* 2017 Jan 20;14:1.
- [62] Moore K, Vaughan B. Students today educators tomorrow. *Clin Teach* 2017 Oct;14(5):325–9.
- [63] Noyer AL, Esteves JE, Thomson OP. Influence of perceived difficulty of cases on student osteopaths' diagnostic reasoning: a cross sectional study. *Chiropr Man Ther* 2017 Dec 1;25(1):32.
- [64] Vaughan B, Morrison T. Assessment in the final year clinical practicum of an Australian osteopathy program. *Int J Osteopath Med* 2015 Dec;18(4):278–86.
- [65] Bright P, Wasik C. Assessing undergraduate osteopaths in the identification of patients' excess body weight. *Int J Osteopath Med* 2013 Dec;16(4):192–7.
- [66] Fletcher P. Clinical competence examination – improvement of validity and reliability. *Int J Osteopath Med* 2008 Dec;11(4):137–41.
- [67] London S. The assessment of clinical practice in osteopathic education: is there a need to define a gold standard? Vol. 11. *Int J Osteopath Med* 2008.
- [68] Abbey H, Esteves JE, Vogel S, Tyreman SJ. Assessing criticality in student research reports: preliminary results from a new educational card sorting activity. *Int J Osteopath Med* 2014 Mar;17(1):12–21.
- [69] Vaughan B, Florentine P. The OSCE in a pre-registration osteopathy program: introduction and psychometric properties. *Int J Osteopath Med* 2013 Dec;16(4):198–206.
- [70] Salmon M, Cretal A, Gonzales-Bandres M. Should person-centredness care be an affordable goal in French osteopathic education? *Int J Osteopath Med* 2022 Mar;43:1–4.
- [71] Vaughan B, MacFarlane C, Florentine P. Clinical education in the osteopathy program at Victoria University. *Int J Osteopath Med* 2014 Sep;17(3):199–205.
- [72] Blanchard PD. A descriptive account of the development of an osteopathic service within a hospital HIV day care centre. *Int J Osteopath Med* 2009;12.
- [73] Kasiri-Martino H, Bright P. Osteopathic educators' attitudes towards osteopathic principles and their application in clinical practice: a qualitative inquiry. *Man Ther* 2016 Feb;21:233–40.
- [74] Zegarra-Parodi R, Fabre L. Critical analysis of teaching spinal manipulation techniques based on the "Fryette laws. *Kinésithérapie* 2009;9(96).
- [75] Licciardone JC. Educating osteopaths to be researchers – what role should research methods and statistics have in an undergraduate curriculum? *Int J Osteopath Med* 2008 Jun;11(2):62–8.
- [76] Zamani J, Vogel S, Moore A, Lucas K. Analysis of exercise content in undergraduate osteopathic education – a content analysis of UK curricula. *Int J Osteopath Med* 2007 Dec;10(4):97–103.
- [77] Sposato N, Shaw R, Bjerså K. Addressing the ongoing friction between anecdotal and evidence-based teachings in osteopathic education in Europe. *J Bodyw Mov Ther* 2018 Jul;22(3):553–5.
- [78] Sommerfeld P. Whose values are we teaching? Deconstructing responsibilities and duties of teachers of osteopathy. Vol. 11. *Int J Osteopath Med* 2008.
- [79] Maretic S, Abbey H. Understanding patients' narratives? A qualitative study of osteopathic educators' opinions about using Medical Humanities poetry in undergraduate education. *Int J Osteopath Med* 2021 Jun;40:29–37.
- [80] McLeod GA, Vaughan B, Carey I, Shannon T, Winn E. Pre-professional reflective practice: strategies, perspectives and experiences. *Int J Osteopath Med* 2020 Mar;35:50–6.
- [81] Moore K. Duty of care in clinical education - Part 1. *Int J Osteopath Med* 2020 Dec;38:1–10.
- [82] Spadaccini J, Esteves JE. Intuition, analysis and reflection: an experimental study into the decision-making processes and thinking dispositions of osteopathy students. *Int J Osteopath Med* 2014 Dec;17(4):263–71.
- [83] Brunt H, Abbey H. An audit of the accuracy of medication documentation in a United Kingdom osteopathic training clinic before and after an educational intervention. *Int J Osteopath Med* 2014 Jun;17(2):102–9.
- [84] Moore K. Duty of care in clinical education in Australian part II. *Int J Osteopath Med* 2020 Dec;38:18–24.
- [85] Palfreyman S, Mercier J, Friedlander T. Pre-entry qualifications as predictors of success in first year osteopathic education. *Int J Osteopath Med* 2018 Mar;27:57–63.
- [86] Wallace SS. Criticality, research, scholarship and teaching: osteopaths as educators - what makes a good teacher? Vol. 11. *Int J Osteopath Med* 2008.
- [87] Macfarlane C, Cornall D. Expanding options: supporting skills transfer from a post-graduate osteopathy program to clinical practice. *Int J Osteopath Med* 2019 Sep;33–34:38–45.
- [88] Nascimento LP, Oliva-Pascual-Vaca A, Renan-Ordine R, Riquelme I, Ricard F, Rodriguez-Blanco C. Comparative assessment of tactile sensitivity between undergraduate and postgraduate health sciences students. *Int J Osteopath Med* 2016 Mar;19:13–9.
- [89] Phillips AR. Professional identity in osteopathy: a scoping review of peer-reviewed primary osteopathic research. *Int J Osteopath Med* 2022 Jun.
- [90] Getz R, Frait S. Osteopathic education: the link between mission and accreditation. *Int J Osteopath Med* 2014;17(1).
- [91] Seffinger MA, Najm WI, Mishra SI, Adams A, Dickerson VM, Murphy LS, et al. Reliability of spinal palpation for diagnosis of back and neck pain. *Spine* 2004 Oct;29(19):E413–25.
- [92] General Osteopathic Council. Osteopathic practice standards. Osteopathic practice standards. United Kingdom; 2018.
- [93] Geri T, Viceconti A, Minacci M, Testa M, Rossetini G. Manual therapy: exploiting the role of human touch. *Musculoskelet Sci Pract* 2019;44.
- [94] Nim CG, Downie A, O'Neill S, Kawchuk GN, Perle SM, Leboeuf-Yde C. The importance of selecting the correct site to apply spinal manipulation when treating spinal pain: myth or reality? A systematic review. *Sci Rep* 2021;11(1).
- [95] Norcini JJ, McKinley DW. Assessment methods in medical education. *Teach Teach Educ* 2007 Apr;23(3):239–50.
- [96] Green A. Assessment of learning and assessment for learning. In: *The TESOL encyclopedia of English language teaching*. Hoboken, NJ, USA: John Wiley & Sons, Inc.; 2018. p. 1–6.
- [97] Kornegay JG, Kraut A, Manthey D, Omron R, Caretta-Weyer H, Kuhn G, et al. Feedback in medical education: a critical appraisal. *AEM Educ Train* 2017;1(2).
- [98] van de Ridder JMM, Stokking KM, McGaghie WC, ten Cate Otj. What is feedback in clinical education? *Med Educ* 2008;42(2).
- [99] Brown C, Ross S, Cleland J, Walsh K. Money makes the (medical assessment) world go round: the cost of components of a summative final year Objective Structured Clinical Examination (OSCE). *Med Teach* 2015;37(7).
- [100] Imanipour M, Ebadi A, Monadi Ziarat H, Mohammadi MM. The effect of competency-based education on clinical performance of health care providers: a systematic review and meta-analysis. *Int J Nurs Pract* 2022;28.
- [101] Hussey T, Smith P. Transitions in higher education. *Innovat Educ Teach Int* 2010 May;47(2):155–64.
- [102] Rodrigues H, Almeida F, Figueiredo V, Lopes SL. Tracking e-learning through published papers: a systematic review. *Comput Educ* 2019;136.
- [103] Regmi K, Jones L. A systematic review of the factors - enablers and barriers - affecting e-learning in health sciences education, vol. 20. *BMC Medical Education*; 2020.
- [104] Cheng M, Taylor J, Williams J, Tong K. Student satisfaction and perceptions of quality: testing the linkages for PhD students. *High Educ Res Dev* 2016;35(6).
- [105] Heffernan T. Sexism, racism, prejudice, and bias: a literature review and synthesis of research surrounding student evaluations of courses and teaching. *Assess Eval High Educ* 2022 Jan 2;47(1):144–54.
- [106] Elliott KM, Healy MA. Key factors influencing student satisfaction related to recruitment and retention. *J Market High Educ* 2001 Jun 14;10(4):1–11.
- [107] MacMillan A, Draper-Rodi J. Osteopathic education: A scoping review protocol. *Int J Osteopath Med* 2023 Mar;47:100648.
- [108] **Educational Resources Information Center- Thesaurus . Evidence Based Practice** <https://eric.ed.gov/?ti=Evidence+Based+Practice>. 2023.
- [109] Gorard S, See BH, Siddiqui N. Context and implications document for: what is the evidence on the best way to get evidence into use in education? *Rev Educ*. 2020;8.
- [110] White H. The twenty-first century experimenting society: the four waves of the evidence revolution. *Palgrave Commun* 2019;5(1):47.
- [111] Weber V, Rajendran D. UK trained osteopaths' relationship to evidence based practice - An analysis of influencing factors. *Int J Osteopath Med* 2018 Sep;29:15–25.
- [112] Browne F. The implementation of the Osteopathic Practice Standards: follow up research by Professor Gerry McGivern and team on exploring and explaining the dynamics of osteopathic regulation. 2020.
- [113] Sundberg T, Leach MJ, Thomson OP, Austin P, Fryer G, Adams J. Attitudes, skills and use of evidence-based practice among UK osteopaths: A national cross-sectional survey. *BMC Musculoskelet Disord* 2018;19(1).
- [114] Lekkas P, Larsen T, Kumar S, Grimmer K, Nyland L, Chipchase L, et al. No model of clinical education for physiotherapy students is superior to another: A systematic review. *Aust J Physiother* 2007;53(1).
- [115] O'Connor A, McGarr O, Cantillon P, McCurtin A, Clifford A. Clinical performance assessment tools in physiotherapy practice education: a systematic review 2018; 104.
- [116] Ødegaard NB, Myrhaug HT, Dahl-Michelsen T, Røe Y. Digital learning designs in physiotherapy education: a systematic review and meta-analysis. *BMC Med Educ* 2021;21(1).
- [117] Cant RP, Cooper SJ. Use of simulation-based learning in undergraduate nurse education: An umbrella systematic review. *Nurse Educ Today* 2017;49.
- [118] Onyura B, Baker L, Cameron B, Friesen F, Leslie K. Evidence for curricular and instructional design approaches in undergraduate medical education: An umbrella review. *Med Teacher* 2016;38.