

3D printing and mind mapping in clinical orthopedic nursing education

Submission date 27/03/2026	Recruitment status No longer recruiting	☐ Prospectively registered ☐ Protocol
Registration date 02/04/2026	Overall study status Completed	☐ Statistical analysis plan ☐ Results
Last Edited 30/03/2026	Condition category Other	☐ Individual participant data ☒ Record updated in last year

Plain English summary of protocol

Plain English summary of protocol not provided at time of registration

Contact information

Type(s)

Public, Scientific, Principal investigator

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Study information

Scientific Title

3D printing and mind mapping in clinical orthopedic nursing education: a comparative randomized controlled trial

Study objectives

To evaluate whether 3D Printing combined with mind-mapping improve knowledge, skills and engagement among nursing interns in orthopedic nursing education.

Ethics approval required

Ethics approval not required

Ethics approval(s)**Primary study design**

Interventional

Allocation

Randomized controlled trial

Masking

Blinded (masking used)

Control

Placebo

Assignment

Parallel

Purpose

To evaluate whether 3D Printing combined with mind-mapping improve knowledge, skills and engagement among nursing interns in orthopedic nursing education.

Study type(s)**Health condition(s) or problem(s) studied**

Eligible participants were third-year nursing students

Interventions

- Randomisation procedure: Participants were randomly allocated (1:1) to either the control group (CG) or observation group (OG) using R software (version 4.3.1). The sample function generated a simple random allocation sequence with the random seed set to 12345 for reproducibility.
- Allocation concealment: The allocation results were printed and sealed in sequentially numbered, opaque, tamper-evident envelopes, stored in a locked cabinet. On the first day of placement, a dedicated secretary opened the next envelope in sequence to reveal group assignment; instructors remained blinded until the envelope was opened.
- Control group (CG): Received traditional orthopedic nursing teaching using PowerPoint slides, X-rays, and plastic models (20 hours over 4 weeks).
- Intervention group (OG): Received the same contact hours (20 hours over 4 weeks) enhanced with 3D printed pelvic fracture models and mind mapping (instructor-constructed and student-generated maps using X-Mind 8.0).

The observation group followed an identical schedule to the control group with equivalent total teaching time of 4 weeks and 5 contact hours per week, supplemented with three additional components. First, instructor-constructed mind maps were created using X-Mind 8.0 centred on "pelvic fracture nursing" with branches covering etiology, classification, peri-operative care and complication prevention. Second, a 1:1 scale 3D printed model of a pelvic fracture was employed to facilitate in-depth exploration of injury mechanisms, diagnostic comparisons, and the nuances

of nursing care, with interactive discussions fostered among interns and the 3D model circulated to enhance learning through multiple sensory modalities. Third, student-generated mind maps were introduced from week 2, where small groups created individual maps, presented them, and revised after peer and instructor feedback, encouraging interns to construct their own mind maps aligned with educational objectives while critically analyzing variances relative to the instructor's version to bolster self-directed learning and critical thinking competencies.

A baseline theoretical assessment (T0) was conducted one day before placement commencement. Upon completion of the 4-week intervention, participants underwent both theoretical and practical assessments (T1), followed immediately by the teaching effectiveness questionnaire (T2). All assessments were administered by evaluators blinded to group allocation.

The Teaching Effectiveness Evaluation Questionnaire is a structured evaluation instrument designed to assess teaching competency specifically within the domain of orthopedic nursing education. The form employed a multi-dimensional approach, evaluating competencies across five core dimensions critical to effective orthopedic nursing instruction and practice. Learning Interest assessed the learner's engagement through active participation in orthopedic case discussions, awareness of advancements in postoperative rehabilitation, and initiative in exploring specialized literature. at Baseline theoretical assessment (T0) was conducted one day before placement commencement. Upon completion of the 4-week intervention, participants underwent both theoretical and practical assessments (T1), followed immediately by the teaching effectiveness questionnaire (T2).

Intervention Type

Other

Primary outcome(s)

1. Nursing knowledge competency measured using the Theoretical Assessment (100-point comprehensive examination covering etiology, pathology, clinical decision-making, and case analysis) at baseline (T0, one day before placement) and at the end of the 4-week intervention (T1)

2. Clinical practical skills measured using the Practical Skills Assessment (structured OSCE-style evaluation based on hospital's "Clinical Nursing Technical Operation Procedures and Standards for 2019," covering preparation, key assessments, procedures, and evaluation) at the end of the 4-week intervention (T1)

Key secondary outcome(s)

1. Teaching effectiveness and student competencies measured using the Teaching Effectiveness Evaluation Questionnaire (15-item, 3-point Likert scale assessing five dimensions: Learning Interest, Clinical Cognitive Abilities, Self-Learning Abilities, Communication and Collaboration Skills, and Summarization/Synthesis Abilities; see Supplementary Material 3) at the end of the 4-week intervention (T2, administered on the same day as T1, within 24 hours after course completion)

Completion date

31/12/2023

Eligibility

Key inclusion criteria

1. Third-year nursing students undertaking their first orthopaedic placement
2. No prior training in 3-D printing or mind-mapping
3. Provided voluntary written informed consent

Healthy volunteers allowed

Yes

Age group

Adult

Lower age limit

18 Years

Upper age limit

35 Years

Sex

All

Total final enrolment

60

Key exclusion criteria

1. Absences exceeding 3 consecutive days or 5 cumulative days during the placement
2. Had previously participated in similar thinking-skills courses
3. Colour-vision or cognitive impairment preventing graphical learning

Date of first enrolment

01/08/2019

Date of final enrolment

31/08/2023

Locations**Countries of recruitment**

China

Sponsor information**Organisation**

Lianyungang Clinical College, Xuzhou Medical University

Funder(s)**Funder type**

Funder Name

Xuzhou Medical University

Alternative Name(s)

, , Xúzhōu Yīkē Dàxué, XZMU

Funding Body Type

Government organisation

Funding Body Subtype

Universities (academic only)

Location

China

Results and Publications

Individual participant data (IPD) sharing plan**IPD sharing plan summary**

Not expected to be made available

Study outputs

Output type	Details	Date created	Date added	Peer reviewed?	Patient-facing?
Other files			30/03/2026	No	No
Other files			30/03/2026	No	No
Other files			30/03/2026	No	No