ORIGINAL ARTICLE

FROM REFLECTION TO PROFESSIONALISM: EVALUATING THE IMPACT OF GUIDED GROUP REFLECTION ON PROFESSIONAL IDENTITY FORMATION IN UNDERGRADUATE MEDICAL STUDENTS

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ABSTRACT

Introduction: Professional Identity Formation (PIF) is fundamental to medical education, shaping students into competent, ethical practitioners.

Objective: This randomized controlled trial (RCT) evaluates the impact of Guided Group Reflection (GGR) on PIF among undergraduate medical students.

Methods: A randomized controlled trial with a mixed-methods approach was conducted at Quaid-e-Azam Medical College, Bahawalpur, Pakistan. Seventy-two students were randomized into either the intervention group (GGR, n = 36), participating in bi-weekly sessions for 12 weeks, or the control group (SDR, n = 36), using reflective journals. Quantitative data were collected using the Professional Identity Questionnaire (PIQ) and the Professional Self-Identity Questionnaire (PSIQ), administered pre- and post-intervention. Qualitative data were gathered through semi-structured interviews and focus group discussions (FGDs). Statistical analysis included paired and independent t-tests, with effect sizes (Cohen's d) and 95% confidence intervals (CIs) reported. Thematic analysis was conducted for qualitative insights, with inter-rater reliability ($\kappa = 0.82$).

Results: The GGR group demonstrated more significant improvements in professional identity ($p < 0.001$, $d = 1.20$), communication skills ($p < 0.001$, $d = 1.50$), teamwork ($p < 0.001$, $d = 1.55$), ethical decision-making ($p = 0.003$, $d = 0.90$), and clinical confidence ($p = 0.009$, $d = 0.85$). The thematic analysis identified four key themes: enhanced self-awareness, strengthened peer collaboration, reinforced professional values, and improved stress management.

Conclusion: Guided Group Reflection fosters professional identity formation in medical students by enhancing self-awareness, ethical reasoning, and teamwork. Its integration into medical curricula can support professional development, particularly in resource-limited settings.

Keywords: *Professional identity formation, guided reflection, medical education, peer support, self-awareness.*

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INTRODUCTION:

Professional Identity Formation (PIF) is a fundamental process in medical education, shaping students into competent, ethical, and reflective physicians. It implies the gradual acquisition of professional values, behaviors, and responsibilities, allowing students to develop a sense of identity as future healthcare professionals.[1,2] PIF is an evolving process influenced by personal experiences, social interactions, and educational strategies meant to support the professional growth of individuals.[3] Reflection is one of the essential aspects of professional identity development,

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enabling students to critically analyze their experiences, evaluate their evolving roles, and integrate professional values into their practice.[4,5] While self-reflection has always been an important aspect of medical education, there is growing recognition of the role of Guided Group Reflection (GGR) in facilitating peer learning, emotional resilience, and collaborative professionalism.[6,7] Theoretical frameworks like Kolb's Experiential Learning Theory and Mezirow's Transformative Learning Theory provide a foundation for understanding the impact of structured reflection on professional identity. Kolb proposed that learning occurs through hands-on experience, reflective observation, conceptual understanding, and the application of new knowledge.[8] Guided group reflection fits this model by helping students critically analyze their clinical experiences, discuss challenges, and apply their knowledge to future practice. Mezirow's theory, on the other hand, emphasizes that deep reflection can transform perspectives, helping students rethink their professional roles and ethical duties.[9] In medical education, guided group reflection (GGR) supports meaningful learning by giving students a structured way to process experiences collectively, gain diverse perspectives, and strengthen their sense of professional identity.[7]

Existing research highlights the benefits of structured reflection in medical education, particularly in improving communication skills, ethical reasoning, and resilience.[10,11] However, much of the literature has focused on Self-Directed Reflection (SDR), where students independently analyze their clinical experiences without external guidance.[12,13] While this can be useful, it misses the benefits of group discussion, peer feedback, and shared learning, which are key to shaping a strong professional identity. Guided Group Reflection (GGR), on the other hand, creates a structured space for students to discuss experiences, exchange insights, and learn from each other.[14] Despite increasing recognition of its advantages, empirical evidence on GGR remains limited, particularly in resource-limited settings where peer collaboration and professional development initiatives are often underutilized. While previous studies highlight the value of reflection in medical education, most focus on the postgraduate level, and few employ rigorous experimental designs, such as randomized controlled trials (RCTs), to assess its direct impact on professional identity formation.

Given the increasing emphasis on team-based learning and interprofessional collaboration in modern healthcare, medical education must evolve to incorporate structured peer reflection as a means of fostering professionalism, resilience, and ethical competence. This study seeks to address the existing research gap by evaluating the impact of Guided Group Reflection on professional identity formation among undergraduate medical students.

METHODS:

Study Design: This study was designed as a randomized controlled trial (RCT) with a mixed-methods approach to evaluate the impact of Guided Group Reflection (GGR) on Professional Identity Formation (PIF) among undergraduate medical students. The study was conducted over three months (August – October 2024).

Setting and Participants: The study was conducted at Quaid-e-Azam Medical College, Bahawalpur, Pakistan, with a total student population of 1,670 across five academic years. Seventy-two students were recruited using stratified random sampling to ensure equal representation. The sample size was determined through power analysis for an

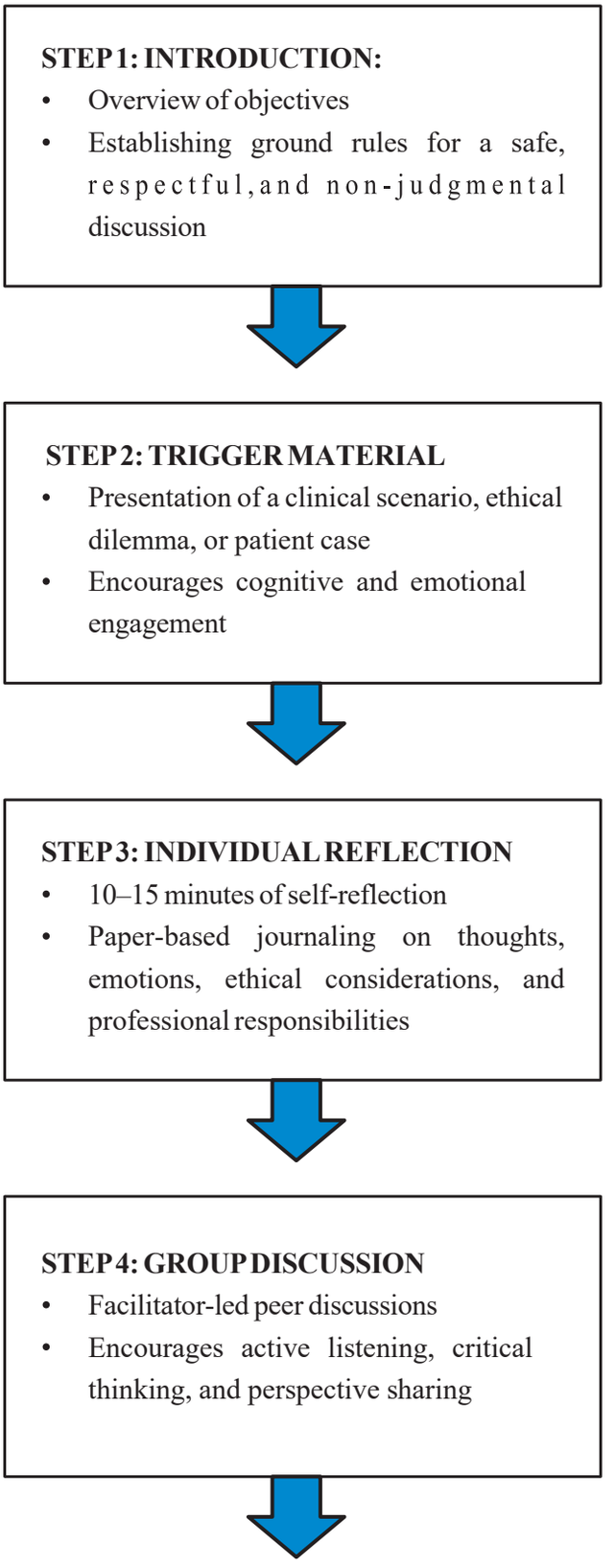
independent two-sample t-test, assuming a moderate effect size (d = 0.7) based on prior studies.[15] With α = 0.05 and 80% power, the minimum required sample was 33 per group, adjusted by 10% for dropout, resulting in 36 students per group (N = 72).

Inclusion criteria: Students who voluntarily agreed to participate and could commit to the 12-week reflection sessions.

Exclusion criteria: Students with prior structured reflection training were excluded to avoid bias in experience comparison.

Intervention:

Guided Group Reflection Sessions: Guided group reflection sessions were implemented as an integral part of the medical curriculum within a professional development course. Participants in the intervention group (n = 36) attended bi-weekly GGR sessions over 12 weeks, with each session lasting 90 minutes. Each group was comprised of 10–12 students, ensuring an interactive and engaging environment. Faculty facilitators were selected based on their expertise in medical education and reflective practices and underwent structured training in reflective facilitation techniques to maintain consistency. Faculty facilitators received a standardized 3-day training on reflective facilitation techniques, ethical discussions, and peer engagement strategies to ensure uniformity across sessions. The training ensured consistency in facilitation across all GGR sessions, minimizing variability in student experiences. Facilitators also participated in periodic calibration meetings to maintain uniformity in reflective discussions. Randomization ensured that facilitators were assigned to different student groups without bias.



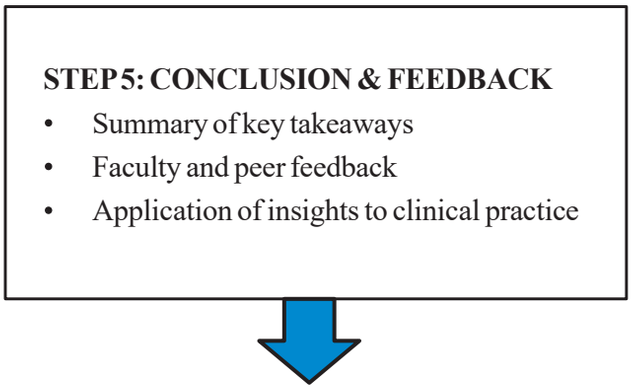


Fig 1: Structured format of guided group reflection sessions in medical education

Data Collection: Participants were randomly assigned to the intervention (GGR) or control (SDR) group using computer-generated randomization (Microsoft Excel RAND function). To ensure allocation concealment, an independent researcher generated the sequence, which was revealed only after recruitment. Blinding measures minimized bias, with researchers unaware of group assignments during data collection and analysis. Additionally, students were not informed of the study hypothesis to reduce expectancy effects.

The intervention group (n = 36) participated in bi-weekly GGR sessions for 12 weeks, while the control group (n = 36) engaged in self-directed reflection (SDR) using reflective journals. Quantitative data were collected using pre-validated tools: the Professional Identity Questionnaire (PIQ) to assess self-perception, ethical commitment, and professional values, and the Professional Self-Identity Questionnaire (PSIQ) to measure competence in communication, teamwork, and ethical decision-making.[16,17]

Qualitative data were gathered through semi-structured interviews and focus group discussions (FGDs). Interviews were conducted with 20 students from each group, while FGDs (8–10 students per discussion) provided deeper insights into peer interactions and shared learning experiences.

Data Analysis: Quantitative analysis involved paired t-tests (to compare pre-and post-intervention scores within each group) and independent t-tests (to compare differences between groups). Effect sizes (Cohen's d) and 95% confidence intervals (CIs) were calculated to determine the magnitude of change. Qualitative data were analyzed using Braun & Clarke's six-phase thematic analysis, with two independent coders performing open and axial coding to ensure inter-rater reliability ($\kappa = 0.82$). Observational data were triangulated with interview and survey results to strengthen validity.

Ethical Approval: This study adhered to the principles of the Declaration of Helsinki. Ethical approval was obtained from the Institutional Review Board. Written informed consent was secured from all participants. Confidentiality and anonymity were maintained by assigning coded identifiers instead of names. Students were informed that participation was voluntary and that they could withdraw at any stage without academic consequences.

RESULTS:

Demographic Characteristics of Study Participants: 72 undergraduate medical students participated in the study, with an equal distribution between the intervention (n = 36) and control (n = 36) groups. The mean age of participants was 21.3 ± 1.8 years, with an equal representation of male (n = 36, 50%) and female (n = 36, 50%) students. Demographic characteristics of the study participants are summarized in Table 1.

Table 1: Demographic Characteristics of Study Participants

Variable	Category	Intervention Group (GGR) (n = 36)	Control Group (SDR) (n = 36)	Total (N = 72)
Gender	Male	19 (52.8%)	17 (47.2%)	36 (50%)
	Female	17 (47.2%)	19 (52.8%)	36 (50%)
Academic Year	1st Year	7 (19.4%)	5 (13.9%)	12 (16.7%)
	2nd Year	5 (13.9%)	7 (19.4%)	12 (16.7%)
	3rd Year	8 (22.2%)	4 (11.1%)	12 (16.7%)
	4th Year	6 (16.7%)	6 (16.7%)	12 (16.7%)
	Final Year	5 (13.9%)	7 (19.4%)	12 (16.7%)

Quantitative results: Post-intervention analysis showed that students in the GGR group experienced significantly greater improvements in professional identity formation, communication skills, teamwork, ethical decision-making, and confidence in clinical decision-making compared to the SDR group ($p < 0.05$ for all). Effect sizes were large for professional identity ($d = 1.20$), communication ($d = 1.50$), and teamwork ($d = 1.55$), while moderate improvements were observed for ethical decision-making ($d = 0.90$) and clinical confidence ($d = 0.85$). In contrast, the SDR group exhibited only minor or non-significant changes across most domains. A full comparison of pre-and post-intervention scores, including p-values, effect sizes (Cohen's d), and confidence

intervals, is provided in Table 2.

Table 2: Pre- and Post-Intervention Scores for PIS and PSIQ in Both Groups

Measure	Group	Pre-Intervention (Mean ± SD)	Post-Intervention (Mean ± SD)	Mean Difference	p-value	Effect Size (Cohen's d)
Professional Identity Scale (PIS)	**Intervention (GGR)**	3.14 ± 0.62	4.12 ± 0.58	+0.98	<0.001	1.20 (Moderate-Large)
	Control (SDR)	3.10 ± 0.59	3.28 ± 0.61	+0.18	0.087	0.30 (Small, NS)
Communication with Patients	**Intervention (GGR)**	2.89 ± 0.71	4.05 ± 0.66	+1.16	<0.001	1.50 (Large)
	Control (SDR)	2.85 ± 0.72	3.05 ± 0.74	+0.20	0.054	0.35 (Small, NS)
Ethical Decision Making	**Intervention (GGR)**	2.90 ± 0.74	3.75 ± 0.72	+0.85	0.003	0.90 (Moderate)
	Control (SDR)	2.91 ± 0.73	3.60 ± 0.68	+0.69	0.007	0.80 (Moderate)
Teamwork & Peer Support	**Intervention (GGR)**	3.02 ± 0.70	4.20 ± 0.66	+1.18	<0.001	1.55 (Large)
	Control (SDR)	3.01 ± 0.69	3.35 ± 0.68	+0.34	0.041	0.55 (Small)
Confidence in Handling Patient Scenarios	**Intervention (GGR)**	3.05 ± 0.69	3.75 ± 0.72	+0.70	0.009	0.85 (Moderate)
	Control (SDR)	3.04 ± 0.68	3.30 ± 0.67	+0.26	0.052	0.40 (Small, NS)

Qualitative results: A thematic analysis of semi-structured interviews and focus group discussions (FGDs) identified four key themes related to students' experiences with professional identity formation. The comparison between the Guided Group Reflection (GGR) and Self-Directed Reflection (SDR) groups highlights the unique benefits of peer-supported reflection.

1. Developing Self-Awareness in Clinical Encounters

Students in both groups recognized the importance of self-awareness in their clinical interactions, but the depth of reflection differed.

GGR Group: Students reported that structured discussions and peer feedback helped them identify strengths and weaknesses in their communication skills. Many became more mindful of their tone, body language, and patient responses, leading to improved patient- centered communication.

"I used to focus only on asking the right questions, but now I realize that how I ask them— my tone and body language—matters just as much."

SDR Group: While self-reflection helped students recognize challenges, many felt uncertain about their progress due to the lack of external feedback. Some reinforced personal assumptions rather than gaining new insights from different

perspectives.

"Reflecting alone was useful, but I wasn't always sure if I was actually improving."

2. Strengthening Peer Collaboration and Professional Identity

GGR sessions fostered a sense of professional identity through teamwork, whereas SDR remained a solitary process with limited collaboration.

GGR Group: Many students reported a shift from competition to collaboration, realizing that peer discussions created a supportive environment for shared learning. They expressed a stronger sense of professional belonging.

"Before these sessions, I saw my peers as competitors. Now, I see them as colleagues who help me grow."

SDR Group: Students engaged in individual reflection but lacked opportunities to compare experiences with peers. While some shared insights informally, they did not experience the same level of structured peer learning.

"I reflected on my own experiences, but I think I missed out on learning from how others handled similar situations."

3. Reinforcing Professional Values and Ethical Responsibility

Both groups explored ethical challenges, but structured discussions in GGR led to deeper moral reasoning.

GGR Group: Students engaged in guided ethical debates, helping them analyze real-world dilemmas beyond theoretical frameworks. This process increased their confidence in ethical decision-making.

"Before, I thought ethical decisions were simple—just follow the rules. Now, I see that real-life situations are more complex."

SDR Group: While students considered ethical principles independently, they struggled to navigate moral dilemmas without external perspectives. Many wished for discussion-based learning to challenge their views.

"Thinking about ethical dilemmas alone was useful, but I wanted to hear how others would approach the same situation."

4. Managing Stress and Professional Growth

Both groups recognized the emotional challenges of medical training, but GGR participants found stronger support systems through structured discussions.

GGR Group: Students reported that peer discussions normalized their struggles, helping them develop healthier coping mechanisms. Many found that sharing experiences with peers reduced stress and improved resilience.

"I used to think asking for help was a weakness, but through these discussions, I realized that seeking support makes me a stronger doctor."

SDR Group: Self-reflection provided a space to process emotions individually, but students often felt isolated in their struggles. Many lacked a way to validate or compare their emotional responses.

"Writing down my thoughts helped, but I often felt like I was dealing with everything on my own, with no way to validate if I was handling things correctly."

The qualitative findings supported the quantitative findings in that they also showed the positive effects of guided reflection on professional identity development. Improved communication, ethical reasoning, teamwork, and stress management were consistent with students' feedback on their growth. Self-awareness, ethical decision-making, and mindfulness in clinical interactions increased with higher scores on the DOPS, while peer support enhanced trust, learning, and professional identity through shared experiences. Table 3 summarizes the findings of the thematic analysis.

Table 3: Summary of Thematic Analysis

Theme	Sub-Theme	GGR Group (Guided Group Reflection) – Peer-Supported Reflection	SDR Group (Self-Directed Reflection) – Individual Reflection
Developing Self-Awareness in Clinical Encounters	Recognizing Strengths & Weaknesses	Identified strengths and weaknesses through peer feedback and discussion. Became more aware of non-verbal cues and patient interactions.	Reflected individually but lacked external validation, leading to uncertainty about progress.
	Increased Reflection on Patient Communication	Improved ability to engage in meaningful conversations with patients. Peer discussions helped refine active listening and empathetic responses.	Focused primarily on data gathering rather than patient-centered communication. No external feedback for improvement.

Theme	Sub-Theme	GGR Group (Guided Group Reflection) – Peer-Supported Reflection	SDR Group (Self-Directed Reflection) – Individual Reflection
	Gaining Confidence in Difficult Conversations	Developed strategies for handling sensitive discussions (e.g., breaking bad news) with greater emotional control.	Struggled with applying ethical reasoning in real-world situations due to lack of external perspectives.
Strengthening Peer Collaboration and Professional Identity	Building Trust in Peer Interactions	Fostered a collaborative learning environment that encouraged trust and mutual support among peers.	Lacked structured peer discussions, leading to limited collaborative learning opportunities.
	Developing a Shared Professional Identity	Shifted from a competitive mindset to a collaborative one, recognizing peers as allies in professional growth.	Viewed professional development as an individual process, with less emphasis on teamwork and collaboration.
	Learning Through Peer Reflection	Gained insight from peer experiences, leading to deeper reflection on professional challenges.	Relied solely on personal experiences, limiting the breadth of perspectives in professional identity formation.
Reinforcing Professional Values and Ethical Responsibility	Greater Awareness of Ethical Complexities	Engaged in peer-led ethical discussions, leading to more nuanced understanding of moral dilemmas.	Reflected independently but lacked discussion-based learning, making ethical decision-making more uncertain.
	Increased Sense of Professional Responsibility	Developed a stronger sense of accountability for patient care and ethical decision-making.	Recognized ethical responsibilities but lacked structured dialogue to explore alternative viewpoints.
	Confidence in Ethical Decision-Making	Became more independent in ethical reasoning, rather than solely relying on faculty guidance.	Tended to follow standard guidelines without engaging in deeper moral reasoning.
Managing Stress and Professional Growth	Emotional Regulation in High-Stress Situations	Peer discussions provided a supportive space for processing stress, reducing anxiety and burnout.	Self-reflection helped process emotions privately, but lack of peer support led to feelings of isolation.
	Reflection as a Coping Strategy	Used structured reflection as a mechanism for stress management and professional resilience.	Journaling provided emotional relief but lacked external validation and shared coping strategies.
	Seeking Support Instead of Internalizing Stress	Shifted perception of seeking help from a weakness to a strength, encouraging professional peer support.	Relied on individual coping mechanisms, often internalizing stress rather than seeking guidance.

DISCUSSION:

The results of this study demonstrate that Guided Group Reflection (GGR) is more effective than Self-Directed Reflection (SDR) in developing professional identity formation (PIF) among undergraduate medical students. The integration of structured peer discussions, facilitated by experienced educators, resulted in marked improvements in professional identity, communication skills, teamwork, and confidence in clinical decision-making. The study results confirm previous research about collaborative reflection benefits in medical education while providing new insights into its effectiveness in resource-constrained educational settings.

A key outcome of this study is the substantial improvement in professional identity among students who participated in GGR sessions. The intervention group demonstrated a significantly higher increase in Professional Identity Scale (PIS) scores compared to the control group ($p < 0.001$), indicating that structured peer-based discussions foster a stronger sense of professional belonging and self-awareness. This is consistent with prior research suggesting that interactive reflection enhances the internalization of professional values and ethical commitment.[6,7]

Additionally, GGR was found to be better at developing communication skills. The intervention group exhibited a significant improvement in patient communication ($p < 0.001$), whereas the control group showed only minor, non-significant gains. The students also supported these findings through qualitative data, which stated that the structured discussions helped them to enhance their verbal and non-verbal communication. These findings are well aligned with previous studies stating the role of peer feedback in improving communication, highlighting the importance of a guided, interactive approach rather than isolated self-reflection.[11,18]

Collaboration and teamwork improved significantly in the GGR group, with a large effect size ($d = 1.55$) in teamwork and peer support scores. Qualitative findings indicated a shift from competition to a cooperative professional identity, emphasizing shared learning and mutual support. In contrast, the SDR group showed no meaningful changes in peer collaboration, highlighting the need for structured group interactions to develop essential teamwork skills. These findings align with previous literature on the role of guided group reflection in fostering collaboration and professional identity.[19]

Ethical decision-making improved significantly in the GGR group ($p = 0.003$), while the SDR group showed moderate gains. This suggests that even self-directed reflection fosters some ethical awareness, but structured discussions in GGR provided deeper insights into real-world dilemmas. These findings align with research emphasizing the role of guided reflection in ethical reasoning.[20] However, they contrast with studies suggesting self-directed reflection alone is ineffective, requiring some interventions to improve it.[21] The observed improvement in the SDR group may stem from individual cognitive engagement, though the lack of structured dialogue likely limited deeper ethical reasoning.

This study demonstrated that GGR enhances emotional resilience and stress management, with participants reporting better coping, increased confidence ($p = 0.009$), and greater peer support. These findings align with research linking structured reflection to reduced burnout.[22,23] These findings suggest that structured reflection not only fosters professional identity but also promotes psychological well-being, an aspect often overlooked in medical training.

The process of guided group reflection is based on social constructivist theory, according to which a

learner acquires knowledge through active collaboration. This theoretical background also echoes elements of Kolb's experiential learning cycle, which implies that reflection, especially group reflection, improves the learning process as it enables students to think aloud, question their growing knowledge base, and benefit from the views of their peers.[24] Critical reflection is supported by Mezirow's theory of transformative learning, which presupposes that the process of reflecting is crucial for a transformation of perspective.[9] As summarized in Table 4, the identity narratives identified in this study align with these theoretical approaches. The table elucidates how professional identity construction is framed within specific structural and normative contexts, offering actionable strategies for fostering identity formation and professional and personal roles while adapting to diverse challenges in clinical practice.

Table 4: Overview of Identity Narratives and Their Underpinning Structures

Table 4: Overview of Identity Narratives and Their Underpinning Structures

Identity Narratives	Underpinning Structure	Description of Experience	Construction of Identity	Ideal Identity Formation Perspective	Strategies to Achieve Ideal Identity Formation Perspective	Underlying Values and Norms
Policing One's Distance from 'the Locals'	Binary Oppositive Narratives	Maintaining professional boundaries	Asserting professional identity distinct from personal identity	Clear separation between professional and personal identity	Enforcing boundaries, maintaining professional distance	Professionalism, objectivity
Struggling to Become One of 'the Locals'	Binary Oppositive Narratives	Balancing professional and local identity	Integrating professional identity with local community identity	Blending professional identity with community values	Engaging in community activities, embracing local norms	Community engagement, empathy
Fixing Identity Among Ambiguities	Multi-Faceted Narratives	Navigating conflicting roles	Reconciling professional identity within complex roles	Harmonizing multiple professional roles	Developing conflict resolution skills, seeking mentorship	Integrity, adaptability
Maintaining Multi-Faceted Identities for Flexibility	Multi-Faceted Narratives	Adapting to diverse professional demands	Maintaining a flexible identity adaptable to various situations	Sustaining a dynamic and adaptable professional identity	Practicing adaptability, continuous professional development	Flexibility, lifelong learning

Implications for Medical Education: This study shows that Guided Group Reflection (GGR) can be a valuable addition to medical training. It helps students develop a professional identity, teamwork, communication skills, and ethical decision-making. Structured reflection sessions also promote self-awareness, resilience, and stress management—key factors in preventing burnout. With healthcare increasingly focused on collaboration and competency, GGR prepares students for real-world challenges while supporting their mental well-being and long-term career satisfaction.

Strengths: This study has several strengths, including its rigorous randomized controlled trial design, the use of validated assessment tools, and a mixed-methods approach that provided both quantitative and qualitative insights. The use of thematic analysis enriched the findings by capturing students' lived experiences, strengthening the study's validity.

Limitations and Challenges: This study was conducted at a single institution, so the findings may not apply to other settings. While the randomized design and mixed-methods approach add rigor, broader studies are needed to confirm these results. The 12-week timeframe also limits insight into whether GGR's benefits (like professional identity growth) last long-term or impact clinical practice. Longitudinal studies are needed to assess whether these improvements are sustained over time and influence clinical practice. Additionally, though students were randomly assigned, participation was voluntary, raising the possibility of self-selection bias, where students more inclined toward reflection may have engaged differently in GGR. Finally, implementing GGR presents practical challenges, including the need for trained facilitators, structured scheduling, and potential student resistance to reflective practices. Successful integration into medical curricula requires institutional support and faculty development programs to ensure effective and consistent facilitation.

Clinical Applications and Future Directions: While this study primarily focuses on professional identity formation, its findings have important clinical implications. Enhanced communication and ethical reasoning in medical students may improve doctor- patient interactions, reduce medical errors, and increase patient satisfaction. Future research should explore the impact of GGR on clinical performance and patient outcomes, further validating its role in competency-based medical education. Additionally, exploring digital adaptations of GGR, such as virtual reflective groups, could enhance accessibility in remote or resource-limited settings.

CONCLUSION:

This study underscores the critical role of Guided Group Reflection in medical education. The significant improvements observed in professional identity, communication, teamwork, ethical reasoning, and emotional resilience highlight the need for integrating structured reflection sessions into medical curricula. Given the growing emphasis on professionalism and collaboration in modern healthcare, GGR should be widely adopted as a transformative educational strategy to cultivate competent, ethical, and reflective medical practitioners.

DECLARATION OF INTEREST: The authors declare no conflict of interest.

AUTHOR'S CONTRIBUTIONS:

M.F.A: conceptualization of original scientific idea for this project and proofreading of final draft.

M.I.K: Data collection, literature review, and references.

S.N: Data collection, data analysis, and write-up

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