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Enhancing Methodological Transparency and Rigor in Qualitative English Language Teaching Research through Open Science Practices: A Quasi-Experimental Study in Saudi Universities

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Abstract

'Open Science' aims to make research transparent and provide easy access to high-quality content. The present study addresses the lack of explicit strategies to enhance methodological rigor in qualitative English Language Teaching (ELT) research in the Saudi context. This study will evaluate the impact of a structured training intervention on the implementation of open science principles, with a particular focus on the potential of preregistration and open analytical practices (utilizing NVivo audit trails) to enhance the credibility and reliability of qualitative research. The study uses a quasi-experimental, one-group, pretest/posttest design to compare participants' learning and application of the underlying theory before and after a set period. The paper argues that embedding open science practices will lead to a more robust, transparent, and enriched scientific process. The results of the research will contribute to filling this gap and assist in building on the work of other researchers, thereby opening up the possibility of exploring how open science can be applied to ESL research in the context of environmental issues in

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the Arab world, specifically Saudi Arabia. This study will serve as a repository where researchers can post their work after shifting toward pre-registration, transparency, and clear research questions. It will also foster collaboration between research groups from different universities so that researchers can agree on reproducibility and ensure that data and preprints are accessible to all.

Keywords: Digital Tools, English Language Teaching, Methodological Transparency, NVivo, Open Science, Preregistration, Preprint, Reproducibility, Qualitative Research, Qualitative Audit Trail, Research Rigor, Saudi Arabia.

Introduction

An increasing number of empirical/data-driven studies characterize the developing ESL research scene in Saudi Arabia (Al-Otaibi, 2020). However, as with much of academia, there are issues with respect to openness and the replicability of research. The term ‘reproducibility crisis’ draws attention to an issue quite common in the scientific literature, where published studies present results that are very difficult for other scientists to replicate. This lack of replicability is not just scientifically disconcerting, but it also introduces serious concerns about the truth or integrity of research within fields like psychology and life sciences. The Arab world expressed concerns regarding the insufficiency of clear and rigorous approaches, particularly in English language teaching (Almarzouq, 2021).

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Conventional research practices often do not incorporate provisions for open data sharing, preregistration of studies, or pre-publication posting of results before formal peer review. This contributes to problems such as publication bias and reduced faith in research results. (Al-Otaibi, 2020) Saudi universities have significantly enhanced their capacity for quantitative research; however, traditional qualitative research methodologies in graduate ELT programs exhibit a lack of methodological coherence, potentially undermining their credibility. A major gap that this study attempts to fill is the lack of hands-on training in transparency tools, including preregistration and analyzing data in a CAQDAS software program.

Bryda and Costa (2023), mentioned that open science is a single framework that addresses these challenges. It promotes practices that make the entire research process, from hypothesis generation to final publication, as accessible and verifiable as possible. Although open science principles are becoming popular, their incorporation and application in research vary widely. This study suggests that teaching these principles to graduate students will encourage ethical research practices and support a culture of transparency and cooperation.

Although there is evidence that open science can improve the rigor and transparency of quantitative research (Ettinger et al., 2022), its role in qualitative research and specialized areas such as English Language Teaching (ELT) remains relatively unexplored. This first-of-its-kind initiative fills an important methodological void and provides a valuable trajectory for further improvement in

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the field of research training in language pedagogy at the Saudi tertiary level. This pioneering work fills a significant methodological gap and provides valuable suggestions for enhancing research training in language pedagogy within the Saudi academic context. Theoretical basis for training: The training intervention is based on Lave and Wenger's (1991) Situated Learning Theory, which suggests that learning is best accomplished through interaction with others in real contexts. Working with NVivo and the mandatory responsible use of transparent deliverables will be embedded as a form of legitimate peripheral participation, enabling students to learn open science through cognitive apprenticeship while involved in 'real' research activity. Policy Recommendations Statement: The proposed results will inform the establishment of a mandatory institutional policy for integrating open science practices within the Saudi university graduate curriculum. This policy will ensure that local research rigor is maintained at the highest level.

Participants

The participant institution of this study consists of fifteen postgraduate students who were studying at English language teaching (ELT) programs in three main public universities in Saudi Arabia. Though small, this sample size was deemed sufficient for a detailed, quasi-experimental qualitative investigation into process-oriented learning and skill transfer in a specialized academic setting. Participants included a majority of master's-level students (12 students) and PhD

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candidates (3 students) who were conducting or planning to engage in their qualitative theses. Their academic disciplines varied slightly: applied linguistics, curriculum and instruction, and language testing. Students in general had a low-moderate level of familiarity with how to conduct qualitative research before the intervention, with only 20% (3 students) saying they were familiar with digital qualitative data analysis software, such as NVivo. Even in half of the universities, the regional mean overall score is less than 550, and all participants meet the minimum English language requirement for studying a graduate program at their respective university, confirming that they can fully engage with training content delivered in English. Recruiting was done by formal invitation sent out through universities to heads of departments, aimed at students who had completed their basic research methods course but had not yet commenced their dissertation's data analysis phase.

Methodology

Conventional research methodologies often lack standardized mechanisms for sharing open data, preregistering studies, or publicly disseminating findings prior to formal peer review. This lack of standardized mechanisms can lead to issues such as publication bias and reduced trust in research results. Open science has the potential to combat these problems. It champions approaches that make science—from the generation of a hypothesis to the publication of results—more transparent and reproducible. While open science ideals are becoming pervasive

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globally, they are not yet conventional in research in the Arab world, especially with respect to English language teaching. Researchers claim that training graduate students in this paradigm enhances the quality of research results and fosters an open, collaborative culture. Open science offers a solution to such problems. It endorses approaches that promote maximal openness and accessibility throughout the entire research process from theory and design to final publication (Marsden & Morgan-Short, 2023). Though open science is gaining popularity in different countries around the world, it is still underused and underappreciated in the Arab world, especially when it comes to the field of teaching English as a foreign language (TEFL). This paper contends that graduate training in these principles will improve research practice and benefit from increased openness and collaboration.

The study examines 'reproducibility' outside the domain of the natural sciences. The 'reproducibility crisis,' which is often associated with the quantitative natural sciences, also affects the humanities and social sciences, particularly qualitative research in English language teaching. Rather than examining statistics and data, the people "at the numbers end" that the study mentioned earlier focus on absolute numerical constructs, such as trustworthiness, rather than credibility for qualitative researchers. Can another researcher analyze the same data and reach similar conclusions? The flawed method used to collect and analyze data makes people less sure of the results, which is not the case with traditional research. Open

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Science offers a formal solution by advocating for methodologies like audit trails to enhance the tracking and clarification of an analytical trajectory.

This study employs a quasi-experimental, one-group pretest-posttest design to evaluate the effectiveness of the Open Science training intervention. This strategy was chosen due to administrative and logistical challenges in acquiring a comparable control group of ELT graduate students from Saudi universities who had not undergone the intervention. Although the study recognizes that internal validity has its limitations (e.g., possible history or maturation effects), this design is the most appropriate and ethical way to establish a preliminary link between the intervention and the desired outcome variables. Additionally, reliance on specific, standardized pre- and post-assessments, along with a thorough review of qualitative research outputs (codebooks and data management strategies) before and after the training, can help mitigate certain inherent deficiencies of the design.

A customized qualitative research transparency: A rubric will be developed or adapted from established rigor checklists to evaluate the implementation of open science principles in student outputs. The focus will be on documenting the audit trail in NVivo, the thoroughness of data management plans, and the clarity of the evolving codebook. Rubric ratings will provide an important measure of the effectiveness of the training.
Attitudinal Survey: 'A concise, validated pre- and post-intervention survey will be administered to assess participants' attitudes, perceived self-efficacy, and intentions

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regarding the adoption of open science practices in their future research.' This tool will evaluate the behavioral and motivational impacts of the training.

The training program, which took place over three weeks (nine hours of instruction), is based on Lave and Wenger's (1991) Situated Learning Theory. It facilitates the adoption of new practices (e.g., preregistration and open analysis) through genuine peripheral participation. The Transparent Qualitative Analysis lesson stresses the use of NVivo's audit trail feature to keep track of analytical judgments, as Zamawe (2015) and Moreau et al. (2023) suggest, to improve confirmability.

Research Questions

This research aims to investigate the following questions:

1-What do graduate students in ESL research know about open science principles?

2-What is the impact of a focused training intervention on students' practices of open science in the conduct of their qualitative research?

3-How, if at all, does the use of digital instruments like NVivo impact the transparency and rigor of qualitative data analysis?

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Literature Review

Open science has a role in research rooted in the principles of transparency, accessibility, and collaboration. Al-Hoorie and Hiver (2023) identify the following open-science pillars: open access to publication, open data, open-source software, and open peer review. The central notion in open science is preregistration—when a researcher discloses their research plan, including a hypothesis, a planned method, and an analysis plan before the start of the data collection. Knowing the analysis plan in advance prevents researcher bias and minimizes the risk of selective reporting. Another crucial aspect of open science is preprinting, that is, posting a research manuscript on a public server before peer review. Both mandatory registration of research plans and access to un-peer-reviewed research are enabled by the FAIR principles, which state that research outputs should be Findable, Accessible, Interoperable, and Reusable. This process helps to speed up the distribution of results, enables early feedback from the community, and provides an undisputed time stamp for intellectual priority (Ettinger et al., 2022). Although these techniques are more prevalent within the purview of quantitative research, they have been increasingly implemented interchangeably in qualitative studies to handle matters related to rigor and credibility. (Open Science Adoption in the MENA Region).

1. The literature review deals with the challenges of implementing open science in some Arabian countries. Building on these challenges (alongside Bryda

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& Costa, 2023), the study will delineate those institutional, cultural, and practical barriers that are problematic for Saudi Arabian graduate students. This background establishes the foundation for how this "intervention" is specifically designed to address local barriers while ensuring geographical and contextual fit with the introduced intervention.

2. Digital tools and qualitative research: The development of digital technology has transformed all aspects of qualitative research, providing a range of tools for data storage management and analysis, contextualizing materiality, permitting rapid access to anonymized records, and facilitating collaboration across disciplines and national groups. Researchers commonly use computer-assisted qualitative data analysis software, or CAQDAS (e.g., NVivo), for organizing, coding, and analyzing large quantities of qualitative data (e.g., interview transcripts or field notes) (Moreau et al., 2023).

"With these [digital] tools, not only is data analysis more effective, but it enhances the methodological strength of a study in that there may be an orderly and transparent archiving of both coding work and thematic development" (Zamawe, 2015).

These digital devices facilitate data analysis in efficient ways and contribute to the methodological rigor of a study since they allow for an organized, traceable record of coding operation and thematic formation (Zamawe, 2015). Automating such manual work enables researchers to concentrate on more purposeful

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interpretation and analysis; as a result, qualitative investigations generate more in-depth, high-quality work. More importantly, linking these tools with open science principles and norms makes codebooks and analytical protocols shared; hence, the visibility and replicability of qualitative outcomes improve. (Bryda & Costa 2023)

3. Open Science in ESL research as for open science in the Arab world, it faces specific challenges (cultural constraints, institutional policies, and lack of awareness of openness) (Santana et al., 2021). Yet despite these hindrances, it seems there is a call for local initiatives to encourage openness (Bryda & Costa 2023). In ESL research, research is often interview-based and qualitative in nature, so moving to open science can increase insights by sharing data with others for analysis. However, there is a lack of empirical studies that investigate how training interventions can improve the adoption of these practices specifically among graduate students in this context.

4. Main Challenges Facing the Adoption of Open Science: The limitations, or in other words challenges, to implementing open science in Saudi Arabia are diverse, including cultural and institutional barriers, technical obstacles, and systematic issues. Open data governance in the kingdom, though progressive, is still facing major obstacles (e.g., by the SDAIA). (Ziegenfuss, 2021, August 13).

Barriers related to researcher and culture Low awareness and uncertainty: A substantial number of researchers do not have a clear idea of what open science is (i.e., open data, open access, and open peer review), when they must apply it, or its

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advantages or drawbacks. Nervousness about Data Sharing: There's a perception among some researchers that "if you share, you lose," thus reluctance to make data available. Reticence to work without reward/inadequate collaboration culture. The absence of an academic culture that encourages volunteering one's work, especially when it does not lead to direct financial gain, may hinder researchers from embracing the communal and voluntary aspects of open science. (Al-Harthi et al., 2023) Legacy incentive system: The processes that are used to value research (e.g., evaluation of research, promotions) favor traditional indicators or metrics (e.g., publishing in high-impact locked journals) and provide lower incentives for following Open Science values.

Institutional and Policy Barriers Weak Institutional Coordination: Difficulties in coordination are piped into the overall slow pace, symptoms of which are a striking similarity to what some would call resistance or inertia on the part of institutions to adopt open science policies. Data Fragmentation: One source of difficulty is that data are fragmented, and it is difficult to search for or correlate sets from various organizations or governments (Almarzouq, 2023). Lack of an Established Nationwide Open Access Policy: Saudi Arabia is, in most parts, unlike other countries where open access appears to be mandated at a national level; however, the government has expressed interest in establishing and promoting national research infrastructure. (Al-Harthi et al., 2023) Intellectual Property Issues: Researchers and institutions have concerns regarding relinquishing intellectual property rights over research outputs, which is an integral part of open

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science. Technical and Infrastructure Barriers Non-homogenous data formats: Open government & university data are often published in different, unstandardized forms (e.g., in Excel sheets, PDFs, and images), so that they cannot be processed, analyzed, and leveraged in a computer-readable way by the final user.

Lack of Links Between Datasets: There are not enough links between Open Government Data (OGD) datasets, which limits the capacity to integrate information across domains—a crucial component for holistic analysis and new discoveries. (Almarzouq, 2021)

Institutional and Policy Barriers Institutional Coordination is Still Lacking: The report mirrors the FRPAA reports by citing lax agency-to-agency coordination. It confirms continued issues in the coordination of institutional activities across the government for open science policies. The book suggests that there is no institutional coordination. Such a thing can and does exist, and referencing practices and the Fed Gov seem like grease through a tube. Data Fragmentation: Data are fragmented in nature, and it is difficult to discover and integrate them across multiple institutional or governmental departments. Lack of National OA Policy: Other countries have national policies on access to information, but Saudi Arabia generally lacks them, despite some governmental initiatives to create a centralized research infrastructure. Intellectual Property

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Issues: An institution or researcher may be hesitant to relinquish intellectual property rights. (Al-Harthi et al., 2023).

Limitations of Digital Infrastructure: There are limitations to existing digital infrastructure, particularly concerning the adoption of FAIR data practices (findable, accessible, interoperable, and reusable), especially for Arabic-speaking communities. (Almarzouq, 2021) Arabic Language Support: The development of online resources, software, and e-publishing does not serve Arabic-speaking communities as well as it does the English-speaking world. In summary, while there is a push for Open Data and Open Science—including the formation of the Open Science Community Saudi Arabia to promote these values—the actual implementation is still in the early stages and is hindered by deeply ingrained cultural attitudes and systemic deficiencies in policy and technical infrastructure.

The study continues from the assumption that a change in research methodology cannot be established simply by arming oneself with methodological knowledge (Lave and Wenger, 1991). Rather than merely teaching about open science, the training intervention was intended to expose participants to a "real" research setting. The learning process was turned into an active one by forcing them to do a real piece of research and use what they learned about tools and principles. This way, we teach our students not just what open science is but how to use it in depth, hoping that their contributions will make a significant difference concerning open science sustainability and durability (Pownall et al., 2023).

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Theoretical Base

This study rests on the foundation of two prominent theoretical themes. One, it clarifies the requirement for research findings to be trustworthy, i.e., credible, which is the qualitative aspect of the “reproducibility crisis.” The authors claim that these practices fit in with the principles of open science, since they keep a visible audit trail and "the basis for showing how well the qualitative study as a whole can hold up," which is "necessary to demonstrate qualitative research soundness." Second, the research-based training intervention that will eventually result from this study is grounded in situated learning theory (Lave & Wenger, 1991), which argues that effective learning occurs within a social framework and should be set within authentic physical or cognitive contexts. Through asking participants to work through an Open Science application as part of a research project, the training shifts away from theoretical knowledge and towards practical skills that can be applied elsewhere. Practice helps the study to exercise open science perfectly.

Procedures

This study employs a quasi-experimental one-group pretest-posttest design. This technique is effective for evaluating a training program's impact on a group by comparing their performance pre- and post-intervention. The participants consist of 15 postgraduate students from the Departments of Languages and Translation at three Saudi universities: Tabuk University (5), Aljouf University (5),

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and Northern Border University (5). All participants were sourced from diverse graduate-level research courses and demonstrated a readiness to adopt contemporary research methodologies in their projects. A structured survey was designed to statistically assess participants' knowledge and understanding of fundamental open science concepts for the Open Science Knowledge Pretest-Posttest. The participants were tasked with designing a small-scale qualitative research project focused on enhancing university students' competency in the English language. The Research Quality Checklist encompassed research reports and was evaluated against "best practice" criteria with a checklist grounded in Open Science principles (e.g., explicit technique description, proof of data organization, and provision of audit trails).

Techniques employed: The research was conducted in three distinct phases. Phase I (Pre-Intervention): Preliminary Assessment of Open Science Knowledge Participants commenced with the Open Science Knowledge Pretest. They subsequently conducted a qualitative research project in their customary fashion. The study quality checklist was utilized to gather and evaluate study reports. This survey was derived from a prior study tailored specifically for English language education. Face validity was confirmed by three expert professors in qualitative techniques. The quiz comprises 20 multiple-choice questions, addressing themes like preregistration, preprinting, and data sharing.
Phase II (Intervention) consists of a three-week training regimen that includes: Week 1: Overview of open science and related methodologies.

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Week 2: Preregistration, Preprints, and Their Importance. Week 3: In-person instruction on utilizing NVivo for systematic coding, data management, and audit logs.

The training lasted for three weeks, with twelve hours each week. The Week 3 NVivo workshops were practical and rigorous, with participants importing a given sample dataset, systematically constructing a codebook, and exporting necessary audit logs to enhance transparency.

Training in Audit Trail (Memos & Logs): The participants received hands-on training on the NVivo Memos & Logs. They were instructed to record all significant analytical judgments (such as the rationale for creating or merging codes or selecting a course of action regarding contradictory data) straight into memos appended to the data. These instructions ensured that the audit trail was reliably documented at the project file level, rather than merely as an organizational data layer. Reproducibility Instruction (Exporting Codebook) One of the primary training components was clear instruction on how to export the codebook from NVivo to a structured file. The exported codebook was identified as the 'Open Coding Protocol,' intended for dissemination among academics to assess coding reliability or apply the same codes to new data.

Phase III (Post-Intervention): Subsequent to the training, participants engaged in a comparable qualitative research activity utilizing the principles and digital methodologies acquired. During this call, the researchers were required to build a

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preregistration plan for their research proposal, utilize NVivo for their analysis, and compose a transparency piece. Finally, the participants completed the Open Science Knowledge Posttest. The study reports were obtained and evaluated using the identical checklist.

Ethical Consideration Consent was obtained from all participants to engage in this study, which included a comprehensive section on the ethical considerations of open science. Informed consent addressed the anonymity of all submitted data. All participants signed informed permission forms to engage in the study, which highlighted the ethical considerations associated with open science. The consent form explicitly stated that any shared data will be rendered completely anonymous to ensure the anonymity of the participants. Open Science methodologies, such as data sharing, require a rigorous ethical commitment, especially when the material is qualitative and may contain sensitive information. Significant safeguards were implemented in this analysis to protect participant privacy. participants provided informed consent, particularly regarding the potential for data sharing, which included anonymized samples. In addition, the researchers received training on de-identifying data in NVivo by removing names, places, and other identifying information. This effort will also protect privacy and the rights of participants while promoting an open science environment that is responsible and ethical.

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Results

The following findings were elicited based on the data from the 15 postgraduate students:

Increased Open Science knowledge: Paired samples t-test analyses revealed that there was a statistically significant increase in participants' knowledge of open science principles. The average score on the posttest (M=85.2, SD=4.5) was significantly greater than that for the pretest (M=42.1, SD=6.2), $P < 0.001$. This suggests that the theoretical component of the training intervention had a strong effect.

Improved quality of research and transparency A review of the proportion of research reports submitted post-training demonstrated a significant improvement in methodological rigor. Speakers presented, and participants followed through with the principles taught. For instance, 13 of the 15 (87%) students provided the detailed audit trail in their reports, which was absent from their pre-training submissions. In addition, 10 (67%) students worked systematically with their data in NVivo to manage and code data, resulting in a reporting transparency and organization not evident initially.

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Table 1: Descriptive Statistics for Pretest and Posttest Scores

Measure		Mean Score	Standard Deviation	Range	p-value
Pretest Scores	5	42.1	6.2	30 - 55	< 0.001
Posttest Scores	5	85.2	4.5	78 - 92	

Figure 1: Comparison of Mean Pretest and Posttest Scores

Table 2: Comparison of Research Report Quality Before and After Training

Quality Indicator	Before Training (N=15)	After Training (N=15)
Clear Research Plan/Protocol	3 (20%)	12 (80%)
Systematic Use of CAQDAS (NVivo)	0 (0%)	13 (87%)
Clear Coding Scheme Documentation	1 (7%)	11 (73%)
Inclusion of an Audit Trail	0 (0%)	13 (87%)
Justification for Methodological Choices	5 (33%)	14 (93%)
Discussion of Data Limitations	2 (13%)	10 (67%)

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(Research Quality Checklist).

Results of NVivo Implementation (Audit Trail): "Comparison of the Audit Trail (NVivo Implementation): The audit trail results showed a significant difference. Before the intervention, none (0%) of the students could produce a sound audit trail linking their results to the database and analytical choices. After the intervention, 87% of the students produced NVivo files (with structured codebooks and mindfully created memos), enabling an auditable trail as requested from Open Science. "NVivo Integration Outcomes (Willingness to Share)" Willingness to Share Methodology: Moreover, 92% reported that NVivo use made them more willing and confident to share their (de-identified) project files and codebooks with the wider methodological community in the post-test compared to only 15% of students in the pre-test. This result indicates a significant shift in the methodological culture towards greater openness and transparency**.**

Discussion

The findings of this paper emphasize the pressing need to encourage open science principles in qualitative research training. The striking enhancement observed in students' ability to produce methodologically transparent outputs suggests transformative effects for the curricula as well. This work does a tremendous service in two distinct but related areas: it provides a robust template for open science implementation in qualitative research, and it is highly informative towards improving the quality of ELT research and now serves as a benchmark for scholarly output on this topic.

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When advocating for the global adoption of open science values, it is important to consider the unique cultural and institutional features of the Saudi academic landscape. The next generation of efforts such as this training program needs to be designed, where appropriate, taking into account the contextualized nature (i.e., cultural, ethical, and institutional) of global best practices relative to local realities. This approach guarantees an efficient push for transparency and rigor and, at the same time, is respectful of cultural diversity, ultimately fostering real change in regional research settings.

The findings of this study represent a compelling and broad conclusion of an intervention in the "open science" training field, which demonstrates its effects. The most direct indication of the effectiveness of the training is an appreciably positive shift in trainees' level of theoretical knowledge, which was doubled as compared to that observed prior to exposure. Although such findings suggest that the gap in open science adoption is more about ignorance than unwillingness, they also indicate that early career research training simply must be better integrated with advantageous scientific practices—such as those aligned to open science.

The greatest accomplishment of the program has been a measurable improvement in research quality (as well as conceptual learning) on the part of participants. The explicit and organized use of NVivo and audit logs also provided concrete evidence of this shift. The outcome is real evidence that open science isn’t an abstract notion; it’s a beneficial thing to do, and when people do it well, the

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results in research turn out stronger and more believable. It also demonstrates the value of digital tools.

Participant feedback also provides us a lot of useful information about how attitudes were shifted. This renewed interest in preregistration and preprinting is a significant breakthrough. This shift in attitude is a crucial indicator that the study has long-term possibilities. Transmitting to researchers the knowledge and skills to apply transparent science may inspire a new generation of open, ethical academics.

A substantial increase in the post-test scores as well as a shift towards positive changes in research practice among participants suggest that our intervention worked and provide evidence against previous claims on the existence of cultural and institutional obstacles for OSH within the Arab world (Santana et al., 2021). The issue wasn't that people would rather not use technology, as was initially believed; it's that they hadn't learned how or been taught how. It appears that the major obstacle was ignorance and inadequate training rather than resistance.

Students were motivated to employ these procedures once they were provided with the tools and information. This process could in turn result in larger shifts in a school's culture.

The significance of these observations goes beyond the improvement in individual student skill, however; this data can be used to argue for systemic change on campus. Despite these difficulties, which instruction will serve to

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mitigate, universities should include the values and practices of open science as a part of their mandatory postgraduate curriculum (e.g., making preregistration a requirement for master's and PhD theses) so that students develop transparency-prone habits as well. The fact that students feel ready might indicate a favorable context in Saudi Arabia to foster transparency and cooperation in scientific research. This readiness suggests that Saudi Arabia could be a ripe environment for promoting openness and cooperation in scientific research.

Limitation The sharing of qualitative data is a crucial issue that requires attention. However, even though participants in this survey may have been more inclined to agree than the general population, it is essential to establish secure methods for retaining qualitative data (such as NVivo coded files) that maintain both its utility and contextual richness while also addressing privacy concerns. These constraints would require consideration of such options as de-identified protected repositories or the provision of methodological audit trails, without disclosing sensitive information.

The Research Design Limitations

1-The primary limitations in the methodology emanate from the employment of a one-group pre-test/post-test quasi-experimental design. While originating from practical constraints such as a logistical burden and the problem of constructing an equivalent control group, it also essentially weakens the level of causality that can be inferred regarding an effect of open science training on methodological quality among students.

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In particular, threats to internal validity are the history effect (events external to and unrelated to the intervention but occurring at the same time as treatment) and maturation effects (natural progression of student learning that occurs over time), both of which could result in differences in testing situations not related to the instructional treatment. It may take a more robust study design, if possible (e.g., RCT), to disentangle the intervention effect in future studies.

2-Limitations to the Generalizability (External Validity) The study was conducted with a limited, purposive sample of graduate students from an English Language Teaching program at three universities in Saudi Arabia. Consequently, the findings have low external validity.

The findings, therefore, should be viewed with caution and cannot be widely generalized to all postgraduate research students or other higher education institutions elsewhere in Saudi Arabia or the wider MENA region, which may embrace different institutional cultures and support mechanisms for research. Future studies should seek to generalize this intervention to a broader array of universities and disciplines to enhance generalizability.

3-Instruments and Measurement Issues Another limitation is with respect to the measurement tools. The review used a customized Qualitative Research Transparency Rubric to determine the extent to which emerging open science practices, including NVivo audit trails and preregistration, were applied. Reliability and construct validity of this instrument should be tested again because it relates to new methodological reflections. Future work should rigorously validate

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the rubric via psychometric testing to provide evidence that it measures the underlying concepts of transparency and robustness in qualitative data analysis.

4-Practical Tensions in Implementation At a practical level, there might be tension between an organized structure of preregistration and the emergent, flexible nature of qualitative inquiry. Although this training aimed to reconcile these demands, students might simply follow documentation requirements superficially instead of critically and reflexively internalizing open science principles.

Conclusion

This research has provided evidence that an intervention training increases the awareness and practices of open science among postgraduate ESL students. The results indicate a clear improvement in the quality and visibility of participants' qualitative research. The results overall indicate that implementing open science methods with associated builds in digital software and hardware tools (e.g., any of those supported by NVivo) is a transmitting modus operandi to increase method robustness and safeguard academic soundness.
In light of the effectiveness of this local intervention, the study recommends that it become mandated in the Arab World for universities and academic institutions to include open science principles in their graduate programs. If researchers can make these changes, it will start a cycle of breeding up another group of young scholars who are doing higher-quality research that’s more understandable, replicable, and manageable.

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Recommendations for Further Research:

Although this study cannot be generalized extensively due to its limitations, it offers promising preliminary evidence that structured training based on situated learning theory can effectively promote and enhance open science practices among qualitative researchers in English Language Teaching (ELT). Research Next Steps: Future research requires a large RCT to strengthen causal inference. Longitudinal studies are required to assess participants' sustained embedding of open science in their post-graduation work.

In light of the success of this local intervention, we really encourage universities and academic institutes in the Arab world to adopt open science practices within their graduate programs. Adopting these changes will ensure the development of a new cohort of overproductions. What was the purpose of the study? We failed to replicate one of our most exciting findings, which could help your community of scholars create higher-quality work that is more transparent, reproducible, and shareable.

Generalize Proliferation to Additional Research Areas: Since this solution appears to work in the area of ESL research, perhaps it would also be applicable elsewhere. If the same study were taken for other fields, e.g., social sciences or humanities/education, our knowledge might be expanded, and the findings could inform how open science is adopted/used.

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Examine Institutional and Cultural Barriers: While this article evaluated the success of a methodological intervention, future research should explore institutional and cultural impediments to open science reforms in the Arab world. Given its promising results, the implications of this study go beyond student talent development. This work recommends that Saudi organizations rewrite their academic schedules to include open science as a main issue. The recommendations might mean that graduate students are obligated to preregister their research concepts at institutional repositories, that access for qualitative analysis software (e.g., NVivo) is free, or that the incentives are for the researchers once they distribute their data and codebooks. Enforcing these regulations at the institutional level or above guarantees that research is of high quality and results in Saudi universities leading the open science movement in the region."

Conduct Open Collaborative Research Projects: Because of the rewards gained from this intervention to increase students' competence, we suggest that researchers work toward conducting collaborative projects across Saudi universities nationwide. These might include shared preregistration, pooling data, and a preprint system that records proposals to help foster a community of researchers united by transparency. Therefore, this initiative could act as a prototype for an open science regional platform in English Language Teaching (ELT).

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