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Effectiveness of Outcomes-Based and Licensure-Aligned Curricular Interventions on Licensure and Certification Examination Performance in Medical Technology and Medical Laboratory Science Education: A Systematic Review

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Systematic review conducted in accordance with PRISMA 2020

Abstract

Background: Licensure and professional certification examinations are high-stakes external measures of entry-level competence in Medical Technology and Medical Laboratory Science (MT/MLS) education. Programs increasingly use curriculum redesign, competency alignment, practice examinations, focused review programs, and alternative delivery models to strengthen examination readiness, yet the intervention evidence has remained dispersed. **Methods:** A systematic review was conducted using PRISMA 2020. Primary searches of SciSpace, Google Scholar, and PubMed covered 2010 through September 2026. The automated workflow identified 590 records; after removal of 90 duplicates, 500 records were screened. Four reports advanced to full-text assessment. A manual audit excluded one report because its outcome was a mock certification examination rather than an external licensure/certification result. A supplementary completeness check identified one additional eligible study, yielding four studies in the final qualitative synthesis. Because intervention types, study designs, and outcome metrics were heterogeneous, meta-analysis was not appropriate. **Results:** Evidence clustered into four strategies: comprehensive curriculum enhancement, computer-adaptive certification practice, focused licensure-examination preparation, and competency-aligned delivery modality. The Philippine curriculum-enhancement study reported 64/67 passes (95.5%) across three cohorts versus historical institutional rates of 48%-70%. Introduction of a computer-adaptive exam simulator was associated with an increase in mean ASCP BOC score from 505 to 528. A six-week Saudi licensure-preparation program achieved a 100% first-attempt pass rate among 18 interns, 18 percentage points above the prior internal benchmark. In a 198-student US cohort, increasing virtual exposure to laboratory-intensive courses was associated with lower certification scores and first-attempt pass probability, although multiplicity-adjusted inferences were not statistically significant. **Conclusion:** Licensure-aligned curriculum design, deliberate practice with certification-like testing, targeted preparation, and preservation of authentic hands-on laboratory learning appear promising, but the evidence base is small and predominantly nonrandomized. Stronger multi-institutional controlled evaluations with standardized licensure outcomes are needed.

Keywords: *medical laboratory science; medical technology; licensure examination; certification; curriculum; outcomes-based education; competency-based education; systematic review*

1. Introduction

Professional licensure and certification examinations serve as external benchmarks of graduate readiness in Medical Technology and Medical Laboratory Science (MT/MLS). These examination-based quality signals carry systemic weight given intensifying global health workforce shortages and the importance of competency-aligned training pipelines for sustaining supply (Atento, Quinto, & Espelita, 2025). Unlike course grades, which may vary across institutions and instructors, national or professional examinations apply standardized competency expectations to graduates from different programs. Consequently, first-attempt pass rates and examination scores are routinely treated as indicators of program effectiveness, student preparedness, and the alignment between academic curricula and entry-level professional practice. Consistent with this view, secondary-data analyses of national Medical Technology Licensure Examination outcomes have

used institutional passing rates, together with accreditation and recognition status, as proxies for program quality across Philippine higher education institutions (Liwanag, Pacayra, et al., 2026).

Curriculum reform in MT/MLS has taken several forms. Programs have redesigned professional-course sequences, shortened or restructured internships, mapped learning outcomes to national competency standards, embedded comprehensive examinations, introduced computerized exam simulators, and developed focused review or remediation programs. This kind of outcome mapping occurs against a backdrop of broader structural misalignment across the Philippine curriculum-to-competency pipeline, spanning basic education, higher education, technical-vocational training, and professional licensure (Quinto, Atento, et al., 2026). More recently, the rapid expansion of remote and hybrid instruction has raised a related question: whether competency-aligned content delivered with reduced hands-on laboratory exposure produces the same external certification outcomes as in-person laboratory instruction.

The literature is difficult to interpret because much of the published work in laboratory-science education concerns predictors of examination success rather than interventions. Grade point average, course performance, time to examination, and student-related barriers have been examined as predictors of certification performance (Brown et al., 2015; Pelton, 2018; Webster, 2020; Quinto, Del Mundo, et al., 2026), but such studies do not establish whether a program can change outcomes through curricular action. A comparable predictor-focused pattern extends beyond MT/MLS: academic, financial, and psychological factors have similarly been linked to licensure examination performance among accountancy graduates in the absence of a defined program intervention (Dela Cruz et al., 2026). Similarly, simulation studies often measure self-confidence, practical competence, or mock examinations rather than actual licensure or certification performance (Webb et al., 2021). A focused synthesis is therefore needed to distinguish intervention evidence from predictive or surrogate-outcome research. This licensure-driven quality culture also intersects with broader structural pressures on health professions programs, including clinical placement scarcity, faculty strain, and generational shifts in learners' expectations (Atento, Quinto, & Bermido, 2025).

This review evaluates empirical studies in MT/MLS education that link a structured curricular, preparation, assessment, or delivery intervention to an external licensure or professional certification examination outcome. The review emphasizes actual examination performance rather than satisfaction, course grades, perceived competence, or internal assessments alone.

1.1 Review Objective and Research Questions

The objective was to synthesize evidence on whether outcomes-based, competency-based, and licensure-aligned curricular interventions are associated with improved licensure or professional certification examination performance in MT/MLS education.

- RQ1. What outcomes-based, competency-based, or licensure-aligned curricular interventions have been implemented in Medical Technology and Medical Laboratory Science education?
- RQ2. What effects do these curricular interventions have on licensure or professional certification examination performance, including pass rates, first-attempt pass rates, and examination scores?
- RQ3. Which curricular components, including curriculum mapping, review courses, simulation, remediation, mock examinations, formative assessment, and delivery modality, are associated with better licensure or certification outcomes?
- RQ4. What institutional, student, and implementation factors influence the apparent effectiveness of curricular interventions intended to improve licensure or certification examination performance?

2. Methods

2.1 Review Design and Reporting Framework

The review followed the PRISMA 2020 reporting framework (Page et al., 2021). The primary search and screening workflow was generated in SciSpace and then subjected to a manual audit. The manual audit was treated as the governing eligibility decision: records retained by the automated workflow were rechecked against the protocol, and a supplementary scholarly-discovery check was used to test whether a clearly eligible intervention study had been missed by the original search. This audit step resulted in one exclusion from the automated included set and one additional eligible study.

2.2 Eligibility Criteria

Table 1. Eligibility criteria

Domain	Included	Excluded
Population	Students or graduates of Medical Technology, Medical Laboratory Science, Clinical Laboratory Science, or equivalent professional programs.	Other health professions unless MT/MLS results were separately reported.
Intervention	Structured curriculum redesign, competency/outcome alignment, comprehensive review, certification-like practice examinations, remediation, simulation, capstone integration, or a substantive curriculum-delivery change linked to examination readiness.	Predictor-only studies with no educational intervention or structured curriculum/delivery change.
Outcome	Actual external licensure or professional certification pass/fail outcome, first-attempt pass rate, or examination score.	Satisfaction, course grades, perceived competence, internal practical examinations, or mock examinations without an external licensure/certification outcome.
Study type	Original peer-reviewed empirical research with sufficient data to characterize the intervention and external examination outcome.	Reviews, editorials, protocols, conceptual papers, dissertations/theses, institutional reports, and conference abstracts with insufficient extractable data.
Time and language	Published from January 2010 through September 2026; English-language full text.	Published outside the review period or without accessible English-language evidence sufficient for eligibility assessment.

2.3 Information Sources and Search Strategy

Primary searches were conducted in SciSpace, Google Scholar, and PubMed for publications from 2010 through September 2026. Search concepts combined MT/MLS/clinical laboratory science terminology with curricular intervention terms and external examination outcomes. The search was completed on 13 September 2026. No database was reported as searched unless records were actually retrieved from that source.

Table 2. Core search strings

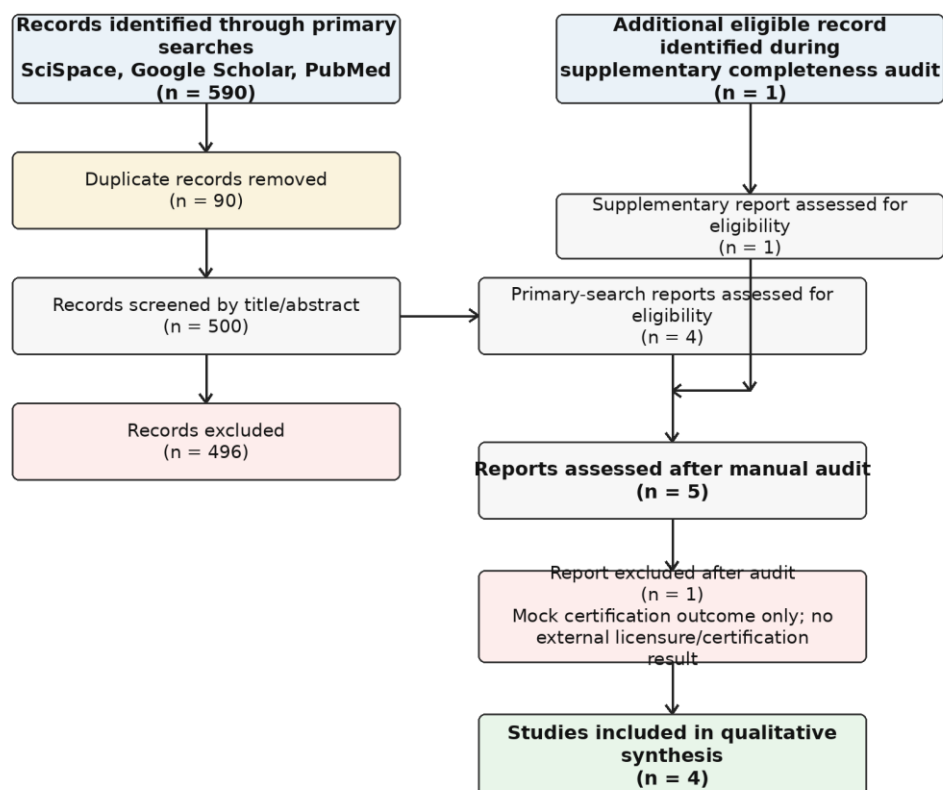
Source	Representative search string
SciSpace	Effects of outcomes-based education, competency-based curriculum, and licensure-aligned interventions on licensure examination performance in medical technology and medical laboratory science programs; and curricular components such as curriculum mapping, review courses, simulation, remediation, mock examinations, and formative assessment linked to certification pass rates.
Google Scholar	("medical technology" OR "medical laboratory science" OR "clinical laboratory science" OR MLS OR MLT) AND ("outcomes-based education" OR "competency-based" OR "licensure-aligned" OR "curriculum mapping") AND ("licensure examination" OR "certification exam" OR "board exam" OR "pass

Source	Representative search string
	rate"). A second search substituted intervention terms including review course, simulation, remediation, mock examination, and formative assessment.
PubMed	("medical technology"[Title/Abstract] OR "medical laboratory science"[Title/Abstract] OR "clinical laboratory science"[Title/Abstract]) AND ("outcomes-based education"[Title/Abstract] OR "competency-based"[Title/Abstract] OR "licensure-aligned"[Title/Abstract]) AND ("licensure examination"[Title/Abstract] OR "certification exam"[Title/Abstract] OR "pass rate"[Title/Abstract]).
Supplementary completeness audit	A targeted scholarly-discovery search for MLS/CLS curriculum interventions, certification practice examinations, and ASCP/other licensure outcomes was conducted after primary screening. One additional eligible report was verified against the journal record and added to the synthesis.

2.4 Study Selection and Manual Audit

The automated workflow identified 590 records. After 90 duplicates were removed, 500 unique records underwent title/abstract screening against the predefined criteria. The workflow excluded 496 records and advanced four reports to full-text assessment. During manual audit, the study by Oja et al. (2016) was removed because its reported examination endpoint was a mock certification examination rather than an actual external licensure or professional certification outcome. A supplementary completeness check identified Blackburn et al. (2018), which described program-wide implementation of a computer-adaptive certification exam simulator and reported actual ASCP Board of Certification outcomes. The final qualitative synthesis therefore contained four studies. No report was lost because of retrieval failure.

PRISMA 2020 study selection flow (audited)



No meta-analysis was performed because study designs, interventions, and examination outcomes were not sufficiently homogeneous.

Figure 1. PRISMA 2020 study-selection flow after manual audit.

2.5 Data Extraction

For each included study, data were extracted on publication year and country, study design, participant cohort, intervention, external examination, numerical examination outcome, and key methodological limitations. When an intervention study also reported internal tests or satisfaction measures, those outcomes were treated as supportive rather than primary evidence. External licensure/certification performance remained the principal outcome for synthesis.

2.6 Quality Appraisal

Because the included evidence comprised nonrandomized program evaluations, a one-group quasi-experiment, and a retrospective cohort, quality was appraised using a harmonized JBI-informed domain framework rather than a single numeric score. Domains were intervention/exposure definition, comparison adequacy, validity of the external examination outcome, control of confounding, completeness/follow-up, and appropriateness of analysis/reporting. Overall judgments were Low risk, Some concerns, or High risk. These ratings are interpretive methodological judgments based on the available reports and are not intended to imply equivalence across different JBI design-specific checklists.

2.7 Synthesis Method

A structured narrative synthesis was used. Meta-analysis was not undertaken because the studies evaluated different interventions and reported noncommensurate outcomes: historical pass-rate comparisons, scaled BOC scores, first-attempt pass proportions, regression coefficients, and adjusted odds. With only four eligible studies and no common controlled effect measure, statistical pooling would have produced a misleading summary estimate.

3. Results

3.1 Characteristics of Included Studies

The four included studies were published between 2013 and 2026 and represented the Philippines, Saudi Arabia, and the United States. Three studies evaluated purpose-designed curriculum or examination-preparation enhancements; one evaluated a competency-aligned delivery-mode change arising during the COVID-19 period. All four linked the educational exposure to an external licensure or professional certification examination.

Table 3. Characteristics and principal findings of included studies

Study	Country / design	Population	Intervention	External examination	Principal finding	Primary limitation
Valdez et al. (2013)	Philippines; curriculum program evaluation with historical comparison	85 graduates; 67 took the licensure examination	Enhanced BSMLS curriculum aligned with CHED standards; restructured professional courses and internship	Philippine Medical Technologists Licensure Examination	64/67 passed across 2010-2012 (95.5%); annual rates 100%, 88%, 100% versus historical institutional rates of 48%-70%.	No concurrent control; historical comparison; descriptive analysis.
Blackburn et al. (2018)	USA; retrospective program evaluation	Senior CLS/MLS students at one institution; exact total cohort not reported in the one-page article	Program-provided computer-adaptive MediaLab Exam Simulator for senior students	ASCP MLS Board of Certification	Mean BOC score increased from 505 to 528 after simulator implementation; simulator performance measures predicted BOC score ($p<.05$).	Sparse reporting; cohort comparability and confounding insufficiently described.
Mansour & Gouda (2025)	Saudi Arabia; one-group quasi-experimental evaluation	18 final-year MLS interns	Six-week structured SLLE preparation program with content review, interactive teaching, and mock assessments	Saudi Laboratory Licensing Examination / SCFHS	18/18 (100%) passed on first attempt; 18 percentage points above the prior internal benchmark; knowledge post-tests also improved ($p<.05$).	No concurrent control; very small single-institution cohort; motivation and secular effects possible.
Turkel et al. (2026)	USA; retrospective cohort / natural experiment	198 graduates with complete data, 2020-2024	Virtual vs in-person delivery of two lab-intensive, competency-aligned preclinical courses	ASCP MLS Board of Certification	Adjusted first-attempt pass: 96.8% (0 virtual), 92.4% (1), 83.3% (2); each additional virtual course: -18.6 BOC points and OR 0.55 for first-attempt pass, but multiplicity-adjusted inference was not significant.	Nonrandomized pandemic-era exposure; residual cohort/time confounding; course-director change in one course.

Table 4. JBI-informed risk-of-bias appraisal

Study	Intervention / exposure definition	Comparison adequacy	Outcome validity	Confounding control	Completeness / follow-up	Analysis / reporting	Overall
Valdez et al. (2013)	Low	High	Low	High	Some concerns	Some concerns	High
Blackburn et al. (2018)	Low	High	Low	High	Some concerns	High	High
Mansour & Gouda (2025)	Low	High	Low	High	Low	Some concerns	High
Turkel et al. (2026)	Low	Some concerns	Low	Some concerns	Low	Low	Some concerns

3.2 RQ1: Types of Curricular Intervention

The evidence mapped to four distinct intervention mechanisms. First, broad curriculum enhancement was represented by Valdez et al. (2013), where the BSMLS curriculum was restructured in response to national policy and competency expectations. The reform modified course combinations, introduced or separated professional subjects, adjusted units and sequencing, and shortened the internship while retaining explicit competency objectives.

Second, certification-like deliberate practice was represented by Blackburn et al. (2018). The program purchased a computer-adaptive exam simulator for senior students, allowing repeated exposure to the format and difficulty of the ASCP Board of Certification examination. This intervention is narrower than full curriculum redesign but directly targets test familiarity, retrieval practice, and calibration against certification-level difficulty.

Third, targeted licensure preparation was represented by Mansour and Gouda (2025). Their six-week intervention combined planned content review, interactive teaching, and mock assessments aligned to the Saudi licensing examination. The program was explicitly designed in response to a decline in first-attempt licensure performance.

Fourth, curriculum delivery modality was represented by Turkel et al. (2026). The underlying content, objectives, and assessment blueprint remained aligned to NAACLS standards and the ASCP content outline, while pandemic-era instruction shifted laboratory-intensive courses from in-person to virtual delivery. This natural experiment therefore provides evidence about the delivery conditions under which a competency-aligned curriculum may or may not translate into external certification performance.

3.3 RQ2: Effects on Licensure and Certification Performance

Across the three purpose-designed enhancement studies, external examination outcomes moved in a favorable direction. Valdez et al. (2013) reported a three-year aggregate pass rate of 95.5% (64/67) after the enhanced curriculum, with annual pass rates of 100%, 88%, and 100%. The authors contrasted these outcomes with the college's pre-intervention five-year passing range of 48%-70%. Because the comparison was historical and no adjustment for cohort differences was performed, the magnitude cannot be attributed solely to curriculum reform, but the direction and persistence of the change are notable.

Blackburn et al. (2018) reported that mean ASCP BOC score increased from 505 before implementation of the computer-adaptive Exam Simulator to 528 after access was introduced. Within the post-implementation cohort, simulator difficulty level, mean practice score, and highest practice score were significant predictors of actual BOC score. This pattern supports the plausibility of deliberate, certification-like practice, but the brief report did not provide enough detail to isolate the simulator effect from cohort or curricular changes occurring over time.

Mansour and Gouda (2025) reported a 100% first-attempt pass rate among 18 interns after the six-week SLLE preparation program, an 18-percentage-point improvement over the institution's preceding cohort benchmark. The absence of a concurrent control and the small sample prevent causal certainty; nevertheless, the alignment between the intervention and the external exam, combined with improvement on internal knowledge measures, provides direct program-evaluation evidence.

Turkel et al. (2026) contributed a contrasting finding. Increasing exposure to virtual delivery was associated with lower external certification performance despite slightly higher course grades in the virtual sections. Adjusted first-attempt pass estimates were 96.8% for students with no virtual preclinical courses, 92.4% with one, and 83.3% with two. Each additional virtual course was associated with an 18.6-point lower BOC total score and an odds ratio of 0.55 for first-attempt passage. These dose-response estimates did not remain statistically significant after multiplicity correction, so they should be interpreted as evidence of an adverse trend rather than definitive proof of harm.

3.4 RQ3: Curricular Components Associated With Better Outcomes

- Explicit alignment to external competency expectations. The interventions associated with favorable outcomes were linked to national policy standards or licensure/certification content rather than generic academic improvement.
- Deliberate practice under certification-like conditions. Computer-adaptive practice and mock assessments were common mechanisms in the Blackburn and Mansour studies, suggesting that repeated retrieval and familiarity with test structure may help translate curricular knowledge into high-stakes examination performance.
- Comprehensive content review close to the examination period. The Saudi intervention concentrated review and practice into a defined six-week period, while the Philippine program embedded additional professional-course content across the curriculum.
- Authentic hands-on laboratory exposure. The Turkel study suggests that preserving psychomotor and bench-reasoning experiences may be important even when theoretical content and local assessments are maintained. Virtual delivery

may support conceptual learning but may not fully substitute for repeated physical laboratory practice in competency domains assessed by external certification.

- Integrated assessment feedback. All four studies relied, to varying degrees, on assessment data to connect curricular performance with external outcomes, but the most actionable models used practice results or competency domains to identify areas requiring reinforcement.

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3.5 RQ4: Contextual and Implementation Factors

Institutional context substantially limits generalization. Each study came from a single institution or program, and licensure systems differed across countries. The intervention effect can therefore be influenced by admissions selectivity, faculty expertise, laboratory resources, clinical affiliation quality, institutional culture, and the difficulty or blueprint of the external examination.

Student-level readiness also matters. Blackburn et al. found that institutional GPA predicted BOC score alongside simulator performance, indicating that an exam-preparation tool does not operate independently of prior academic achievement. Mansour and Gouda acknowledged that motivation and study habits could have contributed to the very high pass rate in their small cohort.

Implementation fidelity and mode of delivery are additional moderators. The Philippine curriculum involved multiple simultaneous changes, preventing isolation of any single component. The Saudi program combined several elements, likewise making component-specific attribution impossible. The US virtual-delivery study maintained stable curricular content but occurred during a pandemic-era transition, creating possible time-related confounding that cannot be fully removed statistically.

4. Discussion

This systematic review found a surprisingly small direct evidence base linking MT/MLS curricular interventions to actual external licensure or certification outcomes. The scarcity is methodologically important. Laboratory-science education has a broader literature on simulation, academic predictors, student perceptions, comprehensive examinations, and certification readiness (e.g., Liwanag, Guzman, et al., 2026), but relatively few studies test whether a defined curricular change translates into better performance on the professional examination itself. This gap explains why a broad initial search produced only four eligible studies after strict outcome auditing.

The available evidence nevertheless suggests a coherent pattern: favorable external examination outcomes were observed when curriculum, assessment, and preparation were deliberately aligned to the competency framework measured by the licensure or certification system.

The Turkel et al. study adds an important qualification. Alignment of topics and local assessments may be necessary but not sufficient in laboratory-intensive education. Their findings suggest that removing or reducing authentic hands-on exposure can weaken the translation of coursework into external certification performance even when the syllabus and assessment blueprint are preserved. The result should not be interpreted as a general rejection of online learning. Rather, it indicates that delivery modality must be matched to the psychomotor, troubleshooting, and tacit bench-reasoning components of the competency being assessed. This tension is consistent with reports from allied health educators themselves, who identified the shift to online delivery during the COVID-19 pandemic as particularly disruptive for skills traditionally requiring face-to-face laboratory sessions (Sayas & Quinto, 2026). It also reinforces the value of structured clinical internship experience, where medical technology graduates and industry partners have rated hands-on competency development and work-ethic formation as central outcomes of laboratory-based training (Dizon, 2026).

The review also cautions against using pass-rate improvement as a simple causal indicator. Three of the four studies lacked a concurrent comparison group, and all studies were conducted within individual programs. Pass rates may change because of admissions policies, student ability, faculty composition, examination difficulty, coaching intensity, or broader institutional changes. The positive findings are therefore best understood as program-evaluation signals rather than definitive causal effect estimates.

From a quality-assurance perspective, the most defensible institutional strategy is not to adopt a single intervention but to establish a continuous licensure-alignment cycle. Programs can map curricular outcomes to the external examination blueprint, use low-stakes certification-like assessments to identify competency gaps, provide targeted remediation or review, preserve authentic laboratory practice for psychomotor domains, and then analyze cohort-level licensure outcomes over multiple years. Such a system converts licensure results from a retrospective ranking metric into a feedback mechanism for curriculum improvement. Graduate tracer feedback linking perceived curriculum quality and internship experience to job readiness offers one practical mechanism for sustaining this feedback loop (Liwanag, Puno, et al., 2026).

4.1 Implications for Medical Laboratory Science Education and Management

- Curriculum mapping should explicitly connect course outcomes, laboratory competencies, and external examination domains, with documented review of gaps and redundancies.
- Programs should consider structured certification-like practice examinations, but should use the results diagnostically for remediation rather than treating practice scores as an end in themselves, consistent with evidence that simulation-based learning strategies are positively associated with perceived clinical competency in other allied health programs (Cabanban et al., 2026).
- Targeted review programs are most defensible when triggered by longitudinal evidence of weak performance and when they include measurable pre/post learning outcomes plus actual first-attempt licensure results.
- Online or hybrid delivery should preserve high-fidelity laboratory practice, troubleshooting, and performance feedback for domains where psychomotor and tacit reasoning are essential.
- Licensure outcomes should be tracked by cohort, domain, first-attempt status, and intervention exposure. Multi-year dashboards can support program review while reducing overinterpretation of a single examination cycle.

4.2 Research Gaps

- Multi-institutional controlled evaluations of curriculum reform are rare.
- Intervention studies seldom report standardized effect sizes or sufficient denominators for direct comparison across programs.
- The independent effects of exam simulation, content review, remediation, curriculum mapping, and clinical exposure remain unclear because most programs implement several components simultaneously.
- Few studies examine whether improvements persist across successive cohorts or whether gains are concentrated among academically at-risk students, a question that connects to broader evidence that non-cognitive factors such as grit and academic motivation shape how allied health students engage with outcomes-based curricula (Maranan et al., 2026).
- Cost, faculty workload, resource requirements, and return on investment of licensure-preparation interventions are largely unreported.
- Comparative evidence from Asian and other non-US licensure systems remains especially limited despite the importance of national licensure examinations in those settings.
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5. Limitations

This review has limitations at both the search and evidence levels. First, the primary automated search used SciSpace, Google Scholar, and PubMed rather than a full suite of bibliographic databases such as Scopus, Web of Science, or CINAHL. A supplementary scholarly-discovery audit identified one additional eligible paper, demonstrating that the primary search was not perfectly sensitive. The supplementary step improves completeness but also constitutes a post-screening audit and should be interpreted transparently as such.

Second, AI-assisted title/abstract and full-text screening was used for efficiency. Final eligibility, however, was manually audited, and the audit altered the automated result by excluding one surrogate-outcome study and adding one eligible certification-outcome study. Third, only English-language peer-reviewed research from 2010 onward was eligible, which may omit relevant older or non-English evidence. Finally, the included studies were heterogeneous and mostly nonrandomized; therefore, the review does not support a pooled causal estimate of intervention effectiveness.

6. Conclusion

Direct evidence connecting MT/MLS curricular interventions to external licensure or certification outcomes is limited but directionally informative. Comprehensive curriculum alignment, certification-like deliberate practice, and focused licensure preparation were associated with favorable examination outcomes, while increased virtual exposure in laboratory-intensive courses was associated with a trend toward weaker external certification performance. The strongest practical implication is not that one intervention guarantees licensure success, but that programs should deliberately align curriculum, practice assessment, remediation, and hands-on training with the competencies measured by the external professional examination. Future research should use multi-institutional comparative designs, standardized outcome reporting, and longitudinal follow-up to distinguish intervention effects from cohort and institutional factors.

References

- Atento, R. G., Quinto, L., & Bermido, C. (2025). A qualitative thematic review of contemporary challenges affecting health professions education: Implications for higher education leadership. *International Journal of Health & Business Analytics*, 1(2). doi:10.65166/yfm5w791
- Atento, R. G., Quinto, L., & Espelita, C. A. M. (2025). Bridging global health workforce gaps 2050: A multilevel analysis of global demand, Philippine supply fragilities, and competency alignment. *International Journal of Health & Business Analytics*, 1(2). doi:10.65166/kgbpey79
- Blackburn, S., Britton, L., & Brunson-Sicilia, L. E. (2018). Predictors of medical laboratory science students' scores on the Board of Certification Exam. *Clinical Laboratory Science*, 31(2), 98. doi:10.29074/ascls.2018000794
- Brown, K. A., Fenn, J. P., Freeman, V. S., et al. (2015). Impact of time lapse on ASCP Board of Certification Medical Laboratory Scientist (MLS) and Medical Laboratory Technician (MLT) examination scores. *Clinical Laboratory Science*, 28(3), 145-150. doi:10.29074/ascls.28.3.145
- Cabanban, I. D., Vidal, E. T., Viadoy, K. M., Talabucon, C., Padua, S. M. J., Lazaro, H. S., Lao, L., Genito, K., Cordero, J. V., Co, Y. G., Carlos, R., Acain, L., Lauresta, A., & Zamora, M. Y. (2026). Simulation-based learning engagement and perceived clinical competency among fourth-year nursing students: A correlational study. *Asian Journal of Educational Leadership, Management and Pedagogy*, 1(1). doi:10.65166/3ek7jk08
- Dela Cruz, J. C. G., Abay, L. J. C., Tungala, M. G. D., & Atento, R.G. (2026). Challenges and factors associated with CPA licensure examination performance in a public higher education institution. *Asian Journal of Educational Leadership, Management and Pedagogy*, 1(1). doi:10.65166/6kdr6589
- Dizon, M. C. S. (2026). Clinical internship performance and outputs of Bachelor of Science in Medical Technology students: The case of a private HEI in Makati. *Asian Journal of Educational Leadership, Management and Pedagogy*, 1(1). doi:10.65166/rsahjx31
- Liwanag, M. C., Guzman, S. A. V., Baldugo, Z. J. K. M., Briones, P. A. Y., Guanzon, P. A. Y., Novilla, E. J. P., Oraiz, A. T., & Seploc, B. L. (2026). Students' evaluation of the Medical Technology Assessment Program Enhancement Initiative for licensure examination preparation. *Asian Journal of Educational Leadership, Management and Pedagogy*, 1(1). doi:10.65166/f2yd6545
- Liwanag, M. C., Pacayra, M. A., Maraña, E., Lajada, A., Binag, L. A., Bargo, J., Ancheta, P. E., Ablola, F. M., Gregana, T. M., & Peñalosa, L. M. (2026). Medical Technology Licensure Examination outcomes in the Philippines: A secondary analysis of HEI passing rates by region and accreditation status, 2018–2023. *International Journal of Health & Business Analytics*, 2(1). doi:10.65166/10nn9c40
- Liwanag, M. C., Puno, S. F., Pagaduan VIII, V. A., Nabayra, I. N. R., Lopez, J. S. J., Gaspar, R. P. K. A., De Los Reyes, A. M. M., Cortez, T. J. R., Aguilar, J. M. L., & Quilicol, L. M. T. (2026). Graduate perceptions of Medical Technology program quality and contributions to job readiness at Centro Escolar University. *Asian Journal of Educational Leadership, Management and Pedagogy*, 1(1). doi:10.65166/f0wyx652
- Mansour, A. A., & Gouda, E. (2025). Evaluating the effectiveness of the Saudi laboratory specialist licensure examination preparation program for the medical laboratory sciences interns: A quasi-experimental study. *BMC Medical Education*, 25, 687. doi:10.1186/s12909-025-07288-3
- Maranan, V. J., Gutierrez, S., Mugisha, V., Magnaye, A. S., & Quinto, L. F. (2026). Grit, AI literacy, and academic motivation among Generation Z allied health students of Mercado College: Implications for outcomes-based education. *Asian Journal of Educational Leadership, Management and Pedagogy*, 1(1). doi:10.65166/f529tt54
- Page, M. J., McKenzie, J. E., Bossuyt, P. M., et al. (2021). The PRISMA 2020 statement: An updated guideline for reporting systematic reviews. *BMJ*, 372, n71. doi:10.1136/bmj.n71

- Pelton, S. B. (2018). Correlation of university comprehensive and national certification exam scores for medical laboratory science students. *Clinical Laboratory Science*, 31, 124-129. doi:10.29074/ascls.2018000216
- Quinto, L. F., Atento, R. G., Lajara, R. S., & Cabrillas Jr., T. (2026). From standards to gaps: A policy-analytical examination of vertical and horizontal curriculum misalignment in the Philippine educational qualification system. *Asian Journal of Educational Leadership, Management and Pedagogy*, 1(1). doi:10.65166/7jvz8p74
- Quinto, L. F., Del Mundo, P. S. S., Dolor, E. F. M., Fuselero, R. M. D., Lo, C. A. B., Nito, S. M. C. L., & Tacata, I. M. C. (2026). Sleep quality, academic stress, time management, and academic performance among Medical Technology students. *International Journal of Behavioral and Social Analytics*, 1(2). doi:10.65166/ec4kzf97
- Sayas, M. K. F., & Quinto, L. (2026). Online education in the allied health professions: Challenges and adaptive strategies among educators in a Philippine university system. *International Journal of Health & Business Analytics*, 2(1). doi:10.65166/jxkysc10
- Turkel, S., Ramirez-Vasquez, M., Abdi, J., & Nasr, P. (2026). Evaluating the impact of remote teaching on competency-based outcomes in clinical laboratory education. *American Journal of Clinical Pathology*, 165(2), aqaf155. doi:10.1093/ajcp/aqaf155
- Valdez, A. P., Panganiban, C. A., & Alday, M. H. (2013). Outcomes of curricular enhancement in a health program: LPU CAMP experience. *IAMURE International Journal of Education*, 7(1). doi:10.7718/iamure.ije.v7i1.563
- Webb, T. L., McGahee, J., & Brown, M. (2021). A scoping review of medical laboratory science and simulation: Promoting a path forward with best practices. *Laboratory Medicine*. doi:10.1093/labmed/lmab087
- Webster, K. E. (2020). Student perceptions of barriers to professional exam success. *Internet Journal of Allied Health Sciences and Practice*, 18(1), Article 13. doi:10.46743/1540-580X/2020.1853

Appendix A. Audit Trail of Automated Screening

The automated workflow initially retained four reports. Manual eligibility audit produced two substantive changes: (1) Oja et al. (2016) was removed because the reported examination endpoint was a mock certification examination rather than an external licensure/certification outcome; and (2) Blackburn et al. (2018) was added after a supplementary completeness search identified an eligible intervention linked to actual ASCP BOC scores. The final evidence set therefore remained four studies, but its composition changed. This adjustment was made before synthesis and is reflected in the audited PRISMA flow diagram and evidence table.