Asian Journal of Social Science and Management Technology
ISSN: 2313-7410
Volume 8, Issue 5, September-October, 2026
Available at www.ajssmt.com

Steam Integration in Second-Degree National Defense and Security Education: A Scoping Review and Proposed Framework

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ABSTRACT:
This evidence-informed scoping review examines the theoretical foundations, transferable international trends, and context-sensitive directions for integrating Science, Technology, Engineering, Arts, and Mathematics (STEAM) education into second-degree National Defense and Security Education (NDSE) programs in Vietnam. The synthesis draws on a purposive corpus of 30 methodological, conceptual, empirical, policy, and legal sources and is organized through a Population-Concept-Context lens. Evidence relevant to teacher preparation clusters around project- and problem-based learning, design thinking and making, interactive technology and simulation, interdisciplinary co-design, and authentic assessment. Direct empirical research involving second-degree NDSE students remains scarce. To address this contextual gap, the article proposes the STEAM-NDSE framework, which connects five components: authentic security or civil-defense problems; interdisciplinary knowledge mobilization; safe digital-physical design and testing; pedagogical transformation; and competency-based evaluation and reflection. Illustrative applications include school-risk mapping, emergency evacuation planning, terrain-model design, misinformation-resilience learning resources, first-aid scenarios, and safe learning-space design. The framework treats prior disciplinary and professional experience as a learning resource while embedding safety, information security, ethics, accessibility, and individual accountability. The review concludes that STEAM integration should begin through small, curriculum-aligned pilot projects and progress only after feasibility, learning quality, and safeguards have been evaluated.

Keywords: STEAM education; national defense and security education; second-degree students; teacher education; scoping review; Vietnam

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1. INTRODUCTION

Higher education is increasingly expected to move beyond the transmission of disciplinary content and develop the capacity to address complex, open-ended problems. Within this shift, STEAM is not simply the co-location of five subjects. It is an interdisciplinary mode of learning in which students mobilize scientific knowledge, technological tools, engineering design processes, artistic and humanistic judgment, and mathematical reasoning to create, test, communicate, and improve a solution [4-10]. In teacher education, the resulting product may be a lesson plan, a learning resource, a simulation scenario, a model, or a structured learning environment rather than a technical device alone.

Second-degree NDSE programs have a characteristic that conventional STEAM studies rarely address: students have already completed at least one university degree and enter the program with heterogeneous disciplinary knowledge, professional histories, and levels of career maturity. This diversity can complicate curriculum standardization, but it also provides interdisciplinary capital for collaborative projects. Students with technology backgrounds may lead data and simulation tasks; those trained in education may contribute pedagogical design; those with management experience may strengthen organization and risk assessment; and those with artistic expertise may improve visualization and communication. Properly structured STEAM learning can therefore convert cohort heterogeneity into a collaborative asset rather than treating it only as an instructional problem.

NDSE combines civic, legal, pedagogical, and practical dimensions. Vietnamese law positions national defense and security education within the national education system, while the current higher-education curriculum is governed by Circular No. 05/2020/TT-BGDDT [27, 28]. Program outcomes commonly involve knowledge of national defense and security, civic responsibility, teaching competence, regulated practical skills, discipline, and situation-responsive judgment. Digital tools, mapping, visualization, simulation, learning-resource design, and data analysis can enrich these outcomes, but any innovation must preserve accuracy, safety, information security, and clear boundaries between educational activity and harmful technical instruction [21, 26-28].

International scholarship has extensively discussed STEAM in school education and increasingly addresses teacher preparation. Evidence nevertheless remains fragmented across teacher-training workshops, maker education, museum-based projects, interactive technologies, arts integration, and policy analysis [11-19]. Vietnamese studies have focused mainly on school-level implementation, teacher readiness, institutional support, and educational technology [21, 23-26]. The intersection of STEAM, second-degree teacher education, and NDSE has not developed into a coherent empirical field. The gap is therefore both evidential and conceptual: there is little direct evidence of effectiveness for the target population and no context-specific framework that specifies what may be integrated, how the integration should occur, and which safeguards should govern it.

Accordingly, this review aims to: (1) synthesize theoretical foundations of STEAM relevant to teacher preparation and NDSE; (2) map transferable pedagogical trends and their reported contributions; (3) identify conditions, barriers, and evidence gaps affecting second-degree students; and (4) propose a context-sensitive framework and phased implementation roadmap for Vietnam.

2. METHODOLOGY

2.1. Review design and reporting boundary

The study uses an evidence-informed scoping design to map concepts, intervention patterns, contextual requirements, and research gaps rather than estimate a pooled effect. The methodological logic follows established scoping-review principles: a broad question, iterative evidence mapping, transparent eligibility criteria, structured charting, and synthesis according to conceptual relevance [1-3, 29]. Because the source manuscript did not contain a reproducible database-export file or a completed screening log, this article does not report numerical PRISMA identification and exclusion counts. It should therefore be read as a bounded, theory-building synthesis of the verified 30-source corpus, not as a claim of exhaustive database coverage. This reporting boundary is made explicit to protect research integrity and prevent unsupported record counts.

2.2. Review questions and PCC framework

The review was guided by four questions: RQ1: Which theoretical foundations and STEAM models are relevant to teacher education? RQ2: Which strategies, trends, and outcomes have been reported in teacher education and contexts adjacent to NDSE? RQ3: Which enabling conditions, barriers, risks, and evidence gaps should be considered for second-degree NDSE students? RQ4: Which components and principles should a framework for Vietnam include?

Table 1. Population-Concept-Context framework

Element	Scope in this review
Population	University students, pre-service and in-service teachers, and teacher educators, with priority given to adult learners and second-degree students.
Concept	Integrated STEM/STEAM education; project-, problem-, and design-based learning; making; simulation; professional competence; and authentic assessment.
Context	Teacher education, interdisciplinary higher education, Vietnamese NDSE, civil-defense education, and educational digital transformation in Vietnam.

2.3. Information sources and search logic

The evidence corpus was assembled from peer-reviewed literature and authoritative policy or legal sources relevant to the four review questions. Search logic combined three term clusters and was supplemented by backward citation checking of foundational STEAM and scoping-review publications. Priority was given to work published from January 2013 to August 2026 because this period captures the rapid expansion of arts-integrated STEM discourse; earlier methodological and conceptual sources were retained when necessary. Bibliographic details and DOI links were independently checked against publisher pages, ERIC records, UNESCO repositories, and official Vietnamese legal or education portals during manuscript revision.

Table 2. Illustrative search-term clusters

Cluster	Illustrative terms
STEAM	"STEAM education" OR "integrated STEAM" OR "STEM to STEAM"
Teacher education	"teacher education" OR preservice OR "pre-service teacher*" OR "in-service teacher*" OR "second degree"
Adjacent context	"higher education" OR "national defense education" OR "security education" OR "civil defense" OR simulation OR Vietnam

2.4. Eligibility criteria

Table 3. Inclusion and exclusion criteria

Criterion	Included	Excluded
Population	Higher-education learners; pre-service or in-service teachers; teacher educators.	School students only, unless the study yielded clear implications for teacher preparation.
Concept	Integrated STEM/STEAM with an interdisciplinary rationale; PBL, design, making, simulation, or competency assessment.	Use of a digital device without an integration objective or pedagogical change.
Context	Teacher education; higher education; NDSE; civil defense; Vietnam; or a demonstrably transferable setting.	Operational combat content or sensitive technical instruction outside an educational remit.
Source type	Peer-reviewed empirical, review, or conceptual work; official policy, legal, and institutional reports.	Promotional material, unsupported opinion, or sources without identifiable authorship.
Language	English or Vietnamese.	Other languages when a sufficiently reliable translation was unavailable.

2.5. Evidence charting and synthesis

Each source was charted by year, country or institutional context, source type, population, form of disciplinary integration, pedagogical strategy, technology, learning product, reported outcome, implementation barrier, and relevance to NDSE. The 30 retained sources were then organized into five analytic categories: methodological guidance (n = 5), STEAM theory and reviews (n = 9), teacher-education studies (n = 7), Vietnam-specific or NDSE-context studies (n = 4), and policy or official sources (n = 5). Thematic synthesis was used to identify transferable mechanisms rather than to rank interventions by a single effect metric. Risk of bias was not used as an exclusion criterion, but evidential limitations were considered when interpreting claims.

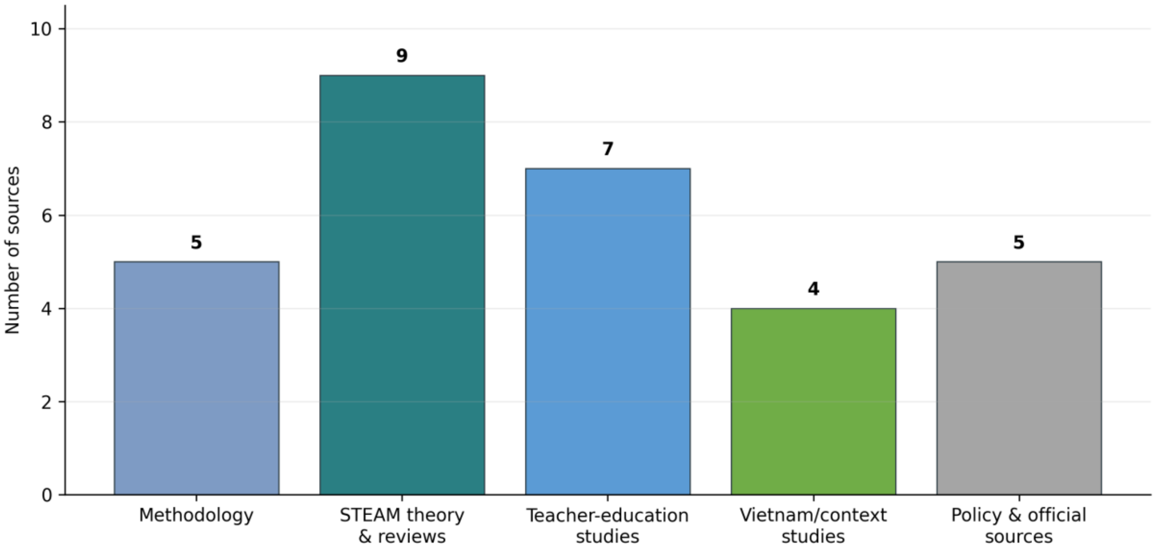

Figure 1. Composition of the 30-source evidence corpus used in the synthesis

3. RESULTS

3.1. Structure and maturity of the evidence base

The evidence base forms three concentric domains. The first contains studies directly concerned with STEAM teacher preparation, including workshops, maker-oriented courses, museum projects, interactive technologies, interdisciplinary lesson design, and teacher self-efficacy [11-18]. The second contains conceptual and review literature on integrated STEAM/STEM, creativity, transdisciplinarity, design, and instructional practice [4-10, 19]. The third supplies contextual evidence on Vietnamese higher education, digital transformation, teacher implementation, and NDSE policy [20-28]. No mature research stream was identified at the exact intersection of second-degree education, STEAM, and NDSE. Consequently, the findings represent structured indirect evidence for framework development, not proof of effectiveness in the target population.

Teacher-education studies consistently show that positive attitudes toward STEAM do not automatically become design competence or high-quality practice. Gess and Kuo found that pre-service special-education teachers required sustained support to translate favorable perceptions into classroom implementation [11]. Falls showed that learners can remain attached to an initial solution even when it inadequately addresses the problem, highlighting the value of external critique and iterative redesign [12]. Interactive technology can strengthen STEAM competence when it is embedded in coherent pedagogy, while maker-oriented and museum-based experiences can connect design, content, and future classroom practice [14-16]. These findings support scaffolding, feedback, and repeated design cycles rather than one-off assignments labeled as creative projects.

3.2. Five transferable trends

Five trends recur across the literature and have plausible transferability to NDSE teacher preparation. They are summarized in Table 4.

Table 4. Transferable STEAM trends and their relevance to NDSE

Trend	Primary learning mechanism	Potential transfer to NDSE
Project- and problem-based learning	Authentic problem, collaborative product, feedback, and improvement.	Evacuation plans, civil-defense learning resources, and school-risk maps.
Design thinking and making	User analysis, problem framing, ideation, prototyping, testing, and revision.	Terrain models, safe-zone prototypes, and communication toolkits.
Simulation and interactive technology	Experience and decision-making in a controlled, low-risk environment.	Decision scenarios, digital mapping, and safe rescue simulations.
Interdisciplinary co-design	Different disciplinary strengths are mobilized through negotiated roles.	Use of expertise from students' first degrees while rotating responsibilities.
Authentic assessment	Evaluation of process, product, justification, reflection, and transfer.	Rubrics for pedagogy, safety, technical accuracy, collaboration, and reflection.

Project-based learning provides a particularly useful architecture for interdisciplinary integration [13, 15]. It becomes STEAM only when the contributing disciplines have functional relationships: decorating a technical artifact does not by itself demonstrate arts integration, and operating software does not automatically demonstrate technological reasoning. Design thinking and making shift the emphasis from learning about a topic to designing for a defined user and context. Here, Arts/Humanities should include communication, visual design, storytelling, ethics, cultural interpretation, and human-centered judgment, not merely decoration [4, 9, 10].

Interactive technology, digital mapping, and simulation can expand practice without recreating hazardous situations. However, UNESCO's Vietnam case study emphasizes that technology adds value only when it fits educational goals, infrastructure, and user capacity [21]. Unequal devices, connectivity, and digital competence can deepen existing disparities. For NDSE, these concerns are compounded by the need to classify information appropriately, protect personal data, use fictional or public datasets, validate content, and stop an activity if risk emerges [26-28].

3.3. Target competencies

Reported outcomes can be consolidated into six learning domains: interdisciplinary understanding; problem solving and design thinking; creativity; digital competence; collaboration and communication; and pedagogical design [4-19]. For second-degree NDSE students, three control competencies should be added: risk assessment, compliance with safety and information-security requirements, and ethical judgment. Creativity is therefore not treated as an isolated outcome but as responsible, accurate, and explainable innovation.

3.4. Characteristics of second-degree learners

The defining feature of second-degree cohorts is the heterogeneity of prior disciplinary capital. A suitable STEAM program should not assume equal initial competence in mathematics, technology, design, or communication. Role-based teamwork can allow students to contribute their initial strengths, but roles must rotate to prevent permanent specialization and unequal learning. Recognition of prior learning should therefore be combined with entry diagnostics, short bridging modules, and common outcome standards.

Adult learners are also likely to be sensitive to relevance and time efficiency. Projects should connect directly to the future work of NDSE teachers, generate reusable products, include short milestones, and require explicit reflection. Highly complex fabrication may add unnecessary cognitive load and displace the pedagogical outcomes that justify STEAM integration.

3.5. Barriers and enabling conditions

Table 5. Design conditions, associated risks, and responses

Condition	Risk if absent	Design response
Instructor capacity	STEAM is reduced to disconnected technology activities.	Modular professional learning; co-teaching; shared topic and rubric banks.
Curriculum and time	Projects are added on top of existing work and overload learners.	Map outcomes first; replace existing fragmented tasks with integrated tasks.
Infrastructure	Device, software, and connectivity gaps restrict participation.	Use minimum viable technology, shared equipment, and offline alternatives.
Safety and information security	Data exposure, inaccurate simulation, or unsafe behavior.	Use fictional/public data, approval gates, role-based access, and safety checklists.
Assessment	Appearance is rewarded more than learning or reasoning.	Assess individual and group evidence, process, justification, and reflection.
Learning culture	Fear of failure or dependence on technology-proficient peers.	Use low-risk prototypes, rotate roles, and provide iterative feedback.

4. PROPOSED STEAM-NDSE FRAMEWORK

4.1. Five interacting components

The proposed framework treats STEAM-NDSE learning as a controlled, iterative design cycle. After testing, a group may return to problem definition, revise criteria, change a representation, or select a safer technology. Three principles apply throughout the cycle: alignment with teacher-education outcomes; safety and information security by design; and equity in access, role allocation, and assessment.

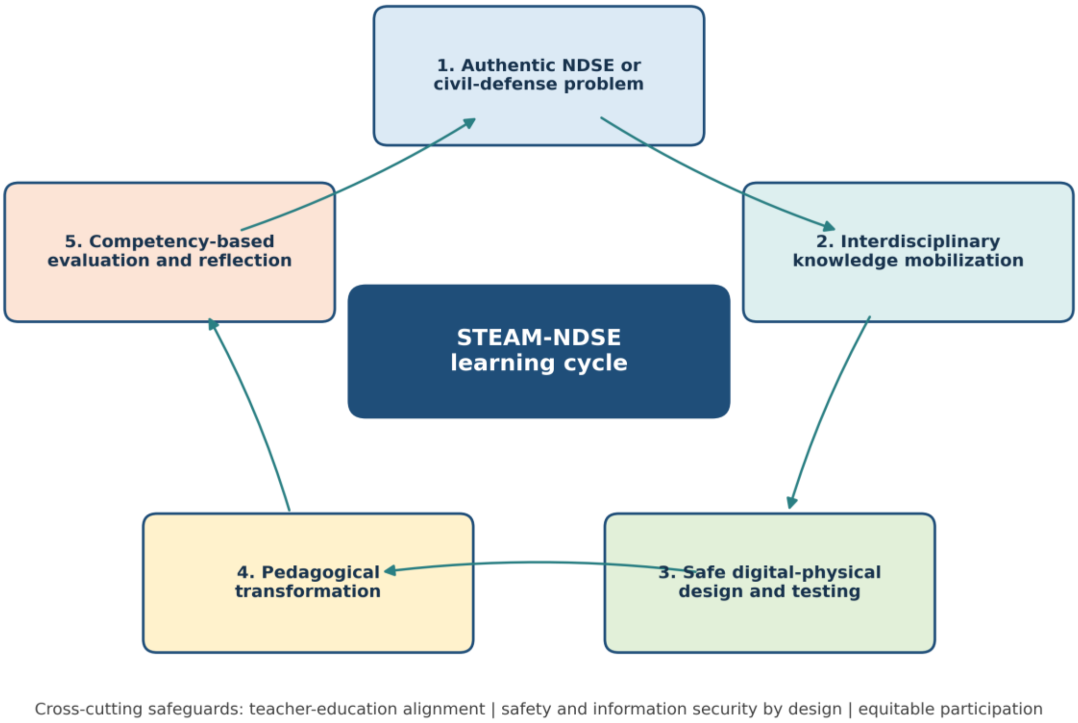

Figure 2. Proposed iterative STEAM-NDSE framework

Table 6. Components of the proposed STEAM-NDSE framework

Component	Design question	Expected evidence
1. Authentic problem	Which school, community, security-education, or civil-defense problem is being addressed?	Context, stakeholders, success criteria, and constraints are explicit.
2. Interdisciplinary mobilization	What cognitive function does each STEAM discipline perform?	A knowledge-skills map demonstrates functional rather than decorative integration.
3. Safe digital-physical design	How will the solution be prototyped, tested, and risk-managed?	A model, map, scenario, or resource with a test log and safeguards.
4. Pedagogical transformation	How does the product become a teachable and inclusive learning experience?	Lesson plan, questions, differentiation, guidance, and feedback design.
5. Competency evaluation	Which evidence demonstrates attainment of the intended outcomes?	Rubric, portfolio, demonstration, individual defense, and reflection.

4.2. Functional roles of the STEAM disciplines

Table 7. Functional contribution of each STEAM discipline

Discipline	Role in NDSE teacher preparation	Illustrative learning evidence
Science	Explain natural, health, environmental, human, and risk-related phenomena.	Causal reasoning, source verification, and defensible scientific assumptions.
Technology	Collect, represent, simulate, and communicate information.	Digital map, interactive resource, simulation, and tool-selection log.
Engineering	Design under constraints; prototype, test, and improve.	Terrain model, procedure, prototype, criteria, and test results.
Arts/Humanities	Visualize, narrate, design experience, and examine ethics and values.	Message, layout, scenario, user analysis, and impact assessment.
Mathematics	Measure, scale, model space and time, estimate probability, and analyze data.	Distance-time calculation, chart, estimate, and uncertainty statement.

4.3. Illustrative application themes

Table 8. Six low-risk application themes

Theme	Expected product	Priority competencies
School-risk mapping	A public-data or fictional digital/offline map with user guidance.	Data, spatial reasoning, communication, and information security.
Multi-scenario evacuation	Route diagram, simplified crowd-flow model, and time schedule.	Problem solving, applied mathematics, accessibility, and safety.
Terrain model for teaching	A physical model and an aligned lesson plan.	Engineering design, scale, visualization, and pedagogy.
Misinformation resilience	Verification scenarios and an evidence-checking protocol.	Information literacy, ethics, source evaluation, and communication.
Community first-aid scenario	A low-risk simulation script and safety checklist.	Health science, collaboration, decision-making, and reflection.
Safe learning-space design	A layout model, rationale, and risk assessment.	Human-centered design, ergonomics, inclusion, and feasibility.

These themes must use public, fictional, or fully de-identified data and remain within educational and civil-defense objectives. They must not include sensitive location data, personal information, weapons instruction, or scenarios that could materially increase harmful capability. Simulations require instructor approval, content validation, and a documented stop procedure.

4.4. Proposed assessment rubric

Table 9. Suggested analytic rubric for a STEAM-NDSE project

Criterion	Suggested weight	Descriptor at the competent level
Accuracy and knowledge integration	20%	Reasoning is accurate; at least three STEAM disciplines have functional relationships.
Design and testing process	20%	Criteria, prototype, test evidence, and documented improvement are present.
Pedagogical value	20%	Product aligns with outcomes, learners, activities, inclusion, and assessment.
Safety, information security, and ethics	20%	Risks are identified; data are appropriate; effective controls are demonstrated.
Collaboration and individual accountability	10%	Roles are transparent; each member can justify key decisions.
Communication and feasibility	10%	Product is clear, accessible, resource-aware, and reusable.

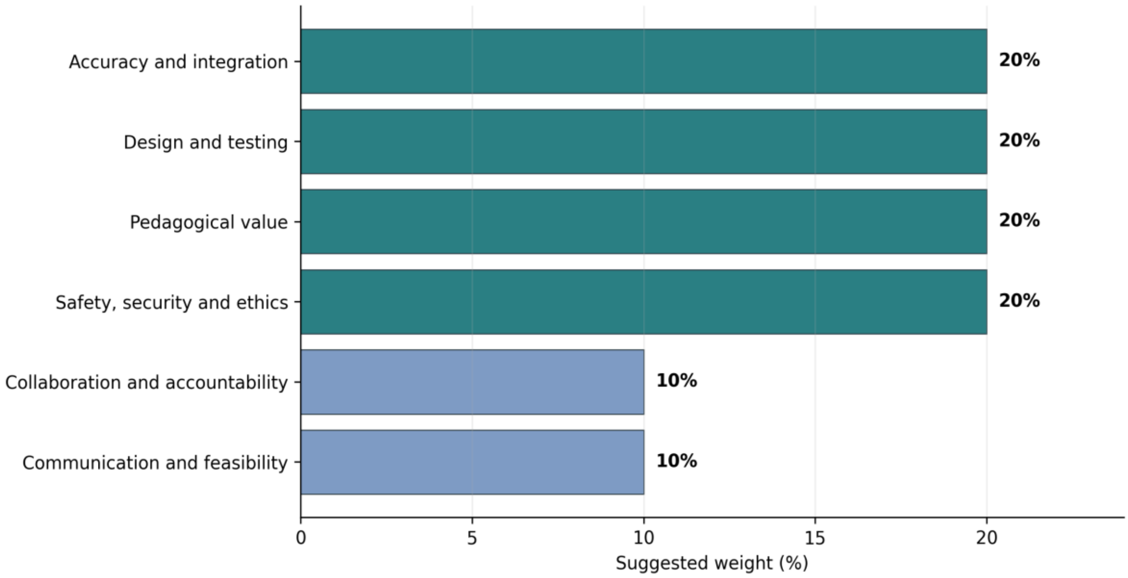

Figure 3. Suggested weighting of the STEAM-NDSE project rubric

5. DISCUSSION

5.1. Theoretical contributions

The first contribution is to reposition STEAM in NDSE as a controlled pedagogical-design model rather than a list of technologies. Its value lies in linking disciplinary knowledge to problem solving and observable evidence of competence. This distinction avoids two common reductions: treating STEAM as STEM with an artistic decoration, and treating innovation as software use alone [4, 5, 9, 17].

The second contribution is to formalize prior-degree interdisciplinary capital as a design resource. In many teacher-education models, differences in student background are treated as noise. In second-degree programs, those differences can support learning when the curriculum uses mixed-expertise teams, constrained open tasks, entry diagnostics, bridging support, and rotating roles. This proposition is a design hypothesis that requires empirical validation.

The third contribution is the integration of risk governance throughout the STEAM cycle. In NDSE, product quality cannot be separated from safety, information security, ethics, accessibility, and factual accuracy. These criteria should not be checked only at the end; they must shape problem selection, data use, prototyping, testing, and dissemination.

5.2. Curriculum and faculty implications

STEAM should be introduced through purposeful replacement rather than curriculum accumulation. Programs should first map existing outcomes against STEAM-NDSE competencies. Selected fragmented assignments can then be replaced by integrated projects lasting approximately three to five weeks. Each project should include short bridging instruction in technology, data, design, or academic communication to reduce differences in entry competence.

The instructor's role shifts from sole presenter to learning-environment designer, content validator, safety gatekeeper, and feedback coach. Co-teaching across NDSE, educational technology, science, arts, or risk management is desirable but resource intensive. A feasible starting model is a project advisory group, an on-call expert network, a shared bank of validated scenarios, and common rubrics.

5.3. Phased implementation roadmap

Table 10. Proposed implementation roadmap

Stage	Main activities	Evidence required before scaling
1. Preparation (0-6 months)	Diagnose learners; train instructors; select one or two themes; develop rubrics, data rules, and safety protocols.	Professional approval of themes; instructors demonstrate minimum design and safeguard competence.
2. Pilot (one semester)	Implement with a small cohort; collect baseline and post-project evidence; observe; interview; test rubric reliability.	Acceptable feasibility, participation, safety, rubric reliability, and competency gains.
3. Scale (1-2 years)	Integrate across selected courses; establish a resource repository and community of practice; evaluate at cohort level.	Stable outcomes, acceptable cost, no increased inequity, and sustainable faculty workload.

5.4. Research agenda

The first priority is qualitative needs assessment with second-degree students, instructors, and program managers to verify relevance, barriers, sensitive content boundaries, and resource conditions. The second is design-based research that develops one exemplary theme through multiple cycles. Once measures and procedures stabilize, a quasi-experimental study could compare classes using rubric scores, pedagogical-design performance, self-efficacy, cognitive load, and qualitative evidence. Longer-term research should examine transfer to teaching practicum and professional practice.

5.5. Limitations

Direct evidence for second-degree NDSE students is extremely limited, and most propositions are transferred from STEAM teacher education or adjacent contexts. Definitions of STEAM, intervention duration, product types, and outcome measures vary substantially across sources. Several studies use small samples, self-report data, or short follow-up periods. In addition, the source manuscript did not provide a reproducible screening log; the present synthesis is therefore bounded to the 30 verified sources and cannot claim exhaustive retrieval. The proposed framework requires expert appraisal, feasibility testing, and empirical validation before effectiveness is asserted.

6. CONCLUSION

Integrating STEAM into second-degree NDSE teacher preparation has a defensible theoretical basis and practical potential, particularly for project-based learning, learning-resource design, public-data mapping, terrain models, civil-defense planning, low-risk simulation, and information-literacy education. Existing evidence supports authentic tasks, iterative design, interactive technology, interdisciplinary collaboration, and process-product assessment, but it also shows that favorable attitudes are insufficient when scaffolding, feedback, and instructor support are weak.

The proposed STEAM-NDSE framework links an authentic problem, interdisciplinary knowledge, safe digital-physical design, pedagogical transformation, and competency-based evaluation. Its central premise is that prior-degree expertise can become learning capital while all students remain accountable to common outcomes. Implementation should start small, replace rather than add tasks, use minimum viable technology, and scale only after evidence confirms feasibility, learning quality, equity, and safety.

7. DECLARATIONS

Ethics approval: Not applicable. This article synthesizes publicly available literature and does not involve human participants or personal data.

Conflict of interest: The author declares no conflict of interest.

Funding: No external funding was reported for this study.

Data availability: The analytic source corpus is fully identified in the reference list. No participant-level or confidential data were generated.

Author contribution: Conceptualization, methodology, synthesis, writing, review, and editing: T.T.H.

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How to cite/reference this article: To Thi Huong, PhD, Steam Integration in Second-Degree National Defense and Security Education: A Scoping Review and Proposed Framework, *Asian. Jour. Social. Scie. Mgmt. Tech*. 2026; 8(5): 01-11.