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STEM EDUCATION IN ALBANIAN CATHOLIC PRIMARY SCHOOLS: TEACHERS' CONCEPTUALISATIONS AND PERSPECTIVES

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Abstract:
Teachers' understandings of STEM shape how they interpret its purposes and possibilities for classroom practice. In this qualitative, interpretive case study I explore how 45 practising teachers from private Catholic primary schools across Albania conceptualise STEM and describe the conditions for its implementation. Data comprised 45 artefacts, including drawings, diagrams and text, and 24 written responses, collected before training at a professional-formation event in June 2025 and representations alongside accounts of current practice and implementation conditions were examined using reflexive thematic analysis informed by visual social semiotics. This study finds that teachers predominantly represented STEM as integrated, learner-centred and developmental, emphasising projects, practical activity, collaboration, creativity and citizenship while engineering design, mathematical evidence, testing and assessment were less visible while written reflections revealed uneven reported implementation, ranging from initial awareness to established integrated practices. Teachers endorsed flexibility and gradual adoption, while identifying professional learning, curriculum alignment, leadership, collaboration, resources and parental relationships as important implementation conditions. The findings distinguish an aspirational visual grammar of STEM from an operational discourse of cautious, conditional optimism. The findings also suggest that relevant pedagogical expertise can precede explicit STEM conceptualisation. Professional development should therefore build on teachers' existing practices while strengthening disciplinary purpose, engineering design, evidence-based reasoning and assessment, supported by curricular and institutional arrangements.

Keywords: Albania; Catholic education; integrated STEM; primary teachers; teacher conceptualisations; visual elicitation; reflexive thematic analysis

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1. Introduction

Science, technology, engineering and mathematics (STEM) has become a powerful language of educational reform, yet the acronym does not designate one agreed curriculum, pedagogy or social purpose. It can refer to strengthened but separate disciplines, purposeful connections between selected subjects, engineering-design activity, digital competence, workforce preparation, inquiry into real-world problems, or a broader project concerned with creativity, citizenship and equity (Bybee, 2013; English, 2016; Honey *et al.*, 2014; McComas & Burgin, 2020; Wong *et al.*, 2016). This elasticity allows STEM to travel across policy and institutional contexts, but it also creates the risk that the label is attached to almost any practical, technological or collaborative activity without a clear account of the disciplinary knowledge and practices involved (McComas & Burgin, 2020; Williams, 2011).

Teachers are central to the meaning that STEM acquires in classrooms; policy language and curricular materials are not implemented mechanically; they are noticed, interpreted, selected and adapted through professional experience, subject confidence, beliefs about learning, school routines and judgements about feasibility (Remillard, 2005; Remillard & Heck, 2014; Spillane *et al.*, 2002). Eliciting teachers' existing conceptualisations is therefore an important starting point for professional learning and for evaluating whether policy ambitions are likely to become coherent classroom practice (Margot & Kettler, 2019; Ring *et al.*, 2017, 2019).

This issue is particularly relevant in Albania, where recent policy announcements have continued to foreground laboratories, digital infrastructure and smart-lab provision, including an initiative for 80 new STEM or science laboratories and the opening or renovation of schools accompanied by further smart-lab expansion (Albanian Telegraphic Agency, 2025a, 2025b). These announcements document material investment and policy intent, but they do not by themselves show how teachers understand integration, how the facilities are used, or whether pupils encounter sustained inquiry, design and evidence-based reasoning. Literature specific to Albanian has likewise drawn attention to the need to distinguish provision from pedagogical meaning (Kacerja *et al.*, 2026; Kosova *et al.*, 2025; Sina *et al.*, 2024; Thanasi & Beqiri, 2024; Zyka & Leskaj, 2026).

Private Catholic schools form a distinctive part of the Albanian educational landscape, their institutional mission is commonly expressed through integral human formation, dignity, community, ethical responsibility and the common good (Congregation for Catholic Education, 2014). At the same time, a Catholic ethos does not automatically supply the disciplinary or pedagogical knowledge required for integrated STEM. The empirical question is how teachers themselves bring professional, institutional and moral resources into their representations of what STEM is and what it is for.

The present study emerged from a wider professional-development need identified by the Komisioni Kombëtar i Edukimit Katolik Shqiptar (KKEKSH; National Commission for Catholic Education in Albania). An internal questionnaire circulated across the Catholic-school network in 2021 indicated repeated demand for new didactic and pedagogical strategies, practical formation and active methodologies, especially project-, problem- and inquiry-based learning (KKEKSH, 2021). That needs assessment informed the organisation of a three-day formation event on active methodologies in 2025 and raised a prior question: before a common account of STEM was taught, what conceptual resources did teachers already possess, and how did they judge the possibilities and constraints of implementation?

To address that question, this study integrates two data strands generated before the formation sessions began. The first consists of 45 participant-produced artefacts responding to an open visual-elicitation prompt. These included conventional drawings, diagrams, words, symbols and mixed forms, and the second consists of 24 substantive pages of follow-up written reflections on current practice, possible implementation, flexibility, and barriers or facilitators. The study therefore examines both the metaphors and spatial relationships through which teachers made STEM visible and the more operational language through which they described feasibility, readiness and institutional conditions.

2. Literature Review

2.1 STEM as a Contested Policy and Educational Object

STEM first gained prominence through policy concerns about scientific capacity, innovation and economic competitiveness, but its contemporary use encompasses disciplinary learning, digital competence, creativity, inclusion, civic problem solving and sustainability (Bybee, 2013; Wong *et al.*, 2016).

The concept of a boundary object is useful for understanding this combination of recognisability and ambiguity. Boundary objects are sufficiently stable to coordinate activity across social worlds, yet flexible enough to sustain locally different meanings (Star & Griesemer, 1989). The STEM acronym can therefore convene ministries, schools, universities, employers and community organisations even when they prioritise different goals. Apparent consensus may conceal disagreement over whether the central purpose is subject attainment, design, employability, creativity, environmental stewardship or equity (Wong *et al.*, 2016; Xhuxhi, 2025). Analytically, the task is not only to ask whether teachers reproduce the four letters, but to examine what holds their representation together and what it authorises or leaves out.

2.2 Disciplinary Integration and Balance

Integrated STEM is often described through a continuum from disciplinary to multidisciplinary, interdisciplinary and transdisciplinary configurations (English, 2016; Honey *et al.*, 2014). In disciplinary provision, science, technology, engineering and mathematics remain distinct; multidisciplinary work places subjects alongside one another around a shared theme, while interdisciplinary work makes deliberate conceptual or procedural connections. Transdisciplinary work is organised around an authentic problem that cannot be addressed adequately through one discipline alone.

A strong integrated approach preserves disciplinary integrity while producing added value through connection (English, 2016; Kelley & Knowles, 2016). Poorly designed integration can dilute concepts, reduce one discipline to decoration, or privilege the field in which the teacher feels most confident (Honey *et al.*, 2014; Williams, 2011).

2.3 Pedagogical Promises and Cautions

STEM is commonly associated with project-based learning, inquiry, collaboration and authentic problem solving because these pedagogies can create a need to mobilise more than one disciplinary practice (Bell, 2010; Pedaste *et al.*, 2015). Project-based learning can support sustained inquiry and the production of a meaningful product, while inquiry-based learning gives prominence to questions, evidence, explanation and reflection. Cross-curricular collaboration can help teachers plan conceptual links that are difficult to sustain in isolated subject lessons (Barlex *et al.*, 2007). These pedagogies are not synonyms for STEM and are not automatically effective. A project can be attractive but conceptually weak; a hands-on task can involve little reasoning; group work can obscure unequal participation; and an apparently integrated theme can leave scientific or mathematical learning implicit (Honey *et al.*, 2014; Williams, 2011). Inquiry can also be constrained by time, curriculum coverage, assessment demands and uncertainty about how to support pupils without supplying every step (Kacerja *et al.*, 2026; Margot & Kettler, 2019). The relevant criterion is therefore the quality of the disciplinary reasoning, design, evidence, participation and reflection within the activity, not the mere presence of practical materials or a project label.

2.4 Teacher Conceptualisations, Sensemaking and Professional Learning

Teacher conceptualizations therefore matter because they shape what counts as a relevant problem, which disciplines are invited to contribute, what pupils are expected to do, and which constraints are perceived as fixed or negotiable (Remillard, 2005; Spillane *et al.*, 2002). Margot and Kettler's (2019) systematic review found that teachers often valued STEM for engagement while reporting barriers partly logistical and partly interpretive, their conclusion was that teachers need usable criteria for recognizing integration and distinguishing STEM from general good teaching or device use.

Studies of teacher conceptions show that shared professional development does not necessarily produce a single definition. Ring *et al.* (2017) found substantial variation in teachers' STEM models across an intensive programme, and Ring *et al.* (2019) later described a continuum of models ranging from the acronym or separate disciplines to real-world problem solving and engineering-design contexts. The value of such models lies in making variation discussable, not in compelling teachers to select one permanent representation (Margot & Kettler, 2019; Spillane *et al.*, 2002).

2.5 Visual Elicitation and Multimodal Meaning

Drawings and diagrams are useful in research on conceptualisation because they allow participants to organise relationships spatially, combine words and images, and employ metaphors that may not appear in a short verbal definition (Guillemin, 2004; Literat, 2013). However, drawings are not transparent pictures of fixed beliefs, they are situated communicative acts shaped by the prompt, available time and materials, visual confidence, familiar diagram conventions and assumptions about the researcher (Kress & van Leeuwen, 2006; Rose, 2016).

Visual social semiotics directs attention to composition and relations between image and text (Jewitt, 2009; Kress & van Leeuwen, 2006). Written annotation may anchor an ambiguous image, extend it, or contradict its apparent message. Analysis should therefore begin with description, privilege participant-provided wording, and treat recurring absences cautiously. A participant cannot include every idea in one artefact, but patterns of presence and silence across a corpus can identify productive questions for follow-up. Integrating visual elicitation with written reflection is particularly valuable because the two modes can reveal different dimensions of the same professional sensemaking.

2.6 Albanian and Catholic-school Context

The developing Albanian literature points to a recurring policy-practice gap, Kacerja *et al.* (2026) showed that preservice mathematics teachers valued investigative work for participation, collaboration, critical thinking and real-life connection, yet found open tasks unfamiliar within a history of routine exercises. Prior to this, Thanasi and Beqiri (2024) raised concerns about continuity between revised secondary mathematics materials and university expectations, while Sina *et al.* (2024) cautioned against treating a STEM label as sufficient evidence of coherent preparation. In 2025, Kosova *et al.* (2025) mapped perceived concerns involving resources, digital competence, textbooks and teacher capacity. These studies do not directly describe practising primary-school teachers, but they establish the relevance of teacher preparation, disciplinary progression and contextual enactment.

Equity and belonging also require attention; data indicate both comparatively strong female participation in some Albanian tertiary STEM fields and continuing field-specific segregation and decline over time (Zyka & Leskaj, 2026). Research with Albanian and Kosovar women studying STEM internationally highlights empowerment and mobility alongside language, gender bias, mentorship and institutional belonging (Kadriu *et al.*, 2026). Such later-stage evidence cannot be projected directly onto primary classrooms, but it reminds researchers to ask who is imagined as participating, whose agency is visible, and whether access to resources is assumed or problematised.

Within Catholic education, integral formation and the common good provide a values-responsive lens rather than a predetermined finding. Laudato si' connects science, technology, ecology, justice and responsibility, inviting evaluation not only of whether a technical solution works but also whom it serves and what consequences it creates (Pope

Francis, 2015). The present study therefore remains open to representations of whole-person development, service, stewardship, community and citizenship, while avoiding the imposition of explicitly religious meaning where participants did not express it (Congregation for Catholic Education, 2014).

There is limited systematic evidence concerning how practising Albanian Catholic primary-school teachers conceptualise STEM before a common definition is supplied, and even less research combining participant-generated visual data with written reflections about current practice and implementation conditions. What remains missing is a participant-anchored account of the conceptual resources, pedagogical aspirations, implementation anxieties, values and silences that teachers bring to the beginning of professional formation, and I aim to address this gap through this study.

3. Theoretical and Analytical Framework

The study adopts a constructivist-interpretive epistemology, where teachers' representations are treated as provisional conceptual constructions developed through prior knowledge, professional experience and social context rather than as fixed objects that can be read directly from a picture (Bruner, 1966; von Glasersfeld & Steffe, 1991). This stance supports attention to how participants select and organise familiar resources when confronted with the open STEM prompt. It also prevents the analysis from treating a sparse artefact as evidence of low competence or a visually elaborate artefact as evidence of superior understanding.

Three complementary lenses specify what the analysis asks of the data: first, the boundary-object lens asks what kind of educational object STEM becomes in each representation, what holds it together and where shared vocabulary conceals ambiguity (Star & Griesemer, 1989; Wong *et al.*, 2016). Second, the disciplinary-integration lens examines whether science, technology, engineering and mathematics are separate, parallel, explicitly connected or organised around an authentic problem, and whether each field is shown as a label or as a functioning practice (English, 2016; Kelley & Knowles, 2016). Third, teacher sensemaking interprets representations and written judgements through prior routines, subject confidence, resources, curriculum expectations and professional identity (Remillard, 2005; Spillane *et al.*, 2002).

Visual social semiotics is used to help in describing the artefacts; these include concepts such as centrality, relative size, framing, overlap, arrows, sequence, roots, pathways, figures and text-image relations (Kress & van Leeuwen, 2006). Through multimodality we see the complete artefact - picture, diagram, labels and words- as the unit of meaning. The follow-up written responses add a second mode that makes perceived feasibility, readiness and organisational conditions more explicit. Across both strands, a contextual values lens asks what STEM is for, who is imagined as participating, and whether knowledge, creativity, confidence, citizenship, inclusion, stewardship or school renewal are made visible.

4. Research Aim and Questions

The aim of the study is to explore how practising teachers in Albanian Catholic primary schools conceptualise STEM education and how they describe the conditions under which it could be implemented in their schools and classrooms.

The study is guided by four research questions:

1. How do teachers visually and textually represent STEM education and the relationships among science, technology, engineering and mathematics?
2. What pedagogical actors, processes, purposes and values are made central, marginal or absent in the initial artefacts?
3. How do teachers describe the current situation regarding STEM in their schools and classrooms, and how do they believe implementation could work?
4. What role do flexibility, teacher readiness and organisational or relational conditions play in hindering or facilitating adoption of integrated STEM pedagogy?

4.1 Method

4.1.1 Research Design

The research uses a qualitative, interpretive and exploratory case-study design (Merriam & Tisdell, 2016; Stake, 1995). The case is bounded by one professional-formation event, a network of private Catholic primary schools in Albania, a shared pre-formation elicitation procedure and the resulting multimodal corpus. The purpose is to understand patterned meanings and significant variation within this bounded setting rather than estimate prevalence among all Albanian teachers. Descriptive counts are used only to orient the reader and are not treated as inferential statistics.

The design combines participant-generated visual elicitation with open-ended written reflection. Both strands are qualitative; the first examines how teachers made STEM visible, while the second examines how they described current practice, possibility and implementation conditions. Their integration provides a multimodal account without converting the qualitative material into a score or developmental ranking.

4.1.2 Setting and Participants

Data were generated in June 2025 during a three-day professional-formation event on active methodologies organised by KKEKSH at the Interdiocesan Seminary of Shkodër. The wider formation addressed student-centred education, project-based learning, inquiry, problem-based learning and learning beyond the classroom. The data collection reported here took place at the beginning of the first day, before the formation session.

The overall participating group comprised 45 consenting practising teachers responsible for STEM-related learning in multiple private Catholic primary schools across Albania. School names, localities, leadership roles and combinations of demographic characteristics are not reported because the Catholic-school network is relatively small and such combinations could enable deductive identification. The group is an information-rich case sample of formation participants, not a statistically representative sample of Albanian primary teachers or Catholic schools.

4.1.3 Data Generation

Participants first responded individually to the open prompt: "What is your understanding of STEM education?" They were invited to communicate their understanding through a picture, diagram, written words, symbols or any combination that they found useful. No time limit was given. The participants were informed that they were not required to produce representational art, and simple, text-only or uncertain responses remained eligible. This openness reduced dependence on drawing skill and allowed participants to choose a mode suited to their conception.

Immediately after the initial task, participants were invited to answer five open questions:

1) What is the current situation in your school regarding the STEM approach?
2) What is the current situation in your own class?
3) How do you think STEM implementation could work in the class and school?
4) Can or should there be flexibility in implementing STEM? and
5) What factors hinder or facilitate teachers' adoption of integrated STEM pedagogy?

Again, no time limit was given to answer these questions.

The 45 initial images containing sheets, V1 to V45, as well as the written pages, coded as W2 to W25, were collected, stored, processed, and participant data were handled in accordance with Albanian data-protection legislation, particularly Law No. 124/2024 On the Protection of Personal Data (Republic of Albania, 2024). The study was additionally informed by the principles established within the European Union's General Data Protection Regulation (European Parliament & Council of the European Union, 2016) and the Council of Europe's modernised Convention 108+ framework (Council of Europe, 2018). The individual image containing sheets and the written page are treated as an analytic unit rather than assumed to have been produced and to represent one unique participant.

4.1.4 Ethics and Confidentiality

Participants completed a written consent form that explained the study, the intended use of the data and the anonymisation of responses. Organisational permission was provided through KKEKSH. The research component was distinguished from attendance at the professional-formation event, and identities are not reported in the article. The ethical approach was informed by the principles of voluntary participation, minimisation of harm, confidentiality and responsible reporting in the British Educational Research Association guidelines (British Educational Research Association, 2018). The participants were informed that they had absolute freedom in responding to questions, and it was for this reason that only 24 written responses were received.

Visual data require particular care because handwriting, drawing style, school names or local examples can remain identifying after a name is removed (Guillemin, 2004; Rose, 2016; Wiles, 2013). For that reason, the article refers to artefacts by code and describes their analytically relevant content rather than reproducing the original sheets. The same principle is applied to participant profiles; exact combinations of school, location, role and experience are suppressed. Consent records and any identity key are kept separately from analytic copies. The images and written response sheets can be made available only where a request is compatible with the original consent, data protection and the continuing risk of recognition within a small professional community.

4.1.5 Analytic Procedure

The two strands were first analysed separately and then compared; the visual analysis combined manifest description, relational analysis, metaphorical interpretation, cross-response comparison and attention to contrasting or negative cases. For each artefact, the analysis recorded visible people, objects, words, shapes, arrows, boundaries, overlap, relative size, centrality, sequence and use of space. It also classified the response as primarily pictorial, diagrammatic, textual or mixed. Description preceded interpretation so that a tree, circle, road or boat was not assigned a universal psychological meaning without considering labels and the wider visual grammar (Kress & van Leeuwen, 2006; Rose, 2016).

The written responses were analysed through semantic coding of explicit statements, interpretive coding of recurring assumptions about learning and change, comparison across the five question areas, and attention to repeated language such as "first steps", "still", "practical", "flexibility", "fear", "collaboration" and "support". Where handwriting was faint or ambiguous, only wording that could be read with reasonable confidence was coded; missing language was not reconstructed. The analysis remained open to negative cases, including programme exclusion, lack of pupil interest, uncertainty and disagreement over whether the curriculum was an obstacle.

Reflexive thematic analysis was used to develop themes around central organising concepts rather than produce a mechanical topic inventory (Braun & Clarke, 2006, 2022). Deductive sensitising domains from Figure 2 - visual form, disciplinary configuration, pedagogy and roles, implementation conditions, values and equity, and tensions or silences - were combined with inductive codes arising from the material. The visual and written themes were then compared through an integrative matrix that examined convergence, complementarity and dissonance. Integration was conducted at group level because a specific written page could not be reliably matched to a specific visual artefact. Indicative counts were generated after theme development to make the distribution of clearly visible patterns transparent. Codes overlapped, the written pages varied in completeness and the counts do not represent independent statistical observations and so they are used as descriptive signposts only. The complete page-by-page audit trails retained simple and contradictory artefacts rather than excluding them for failing to match an integrated-STEM ideal.

5. Findings

The visual and written strands converge on a strongly positive pedagogical vision but contribute different kinds of evidence. The drawings and diagrams are aspirational, relational and metaphorical. They show what STEM is imagined to be, integrated, active, learner-centred, developmental, creative and future-facing. The written responses are more operational and conditional. They show where schools and classes are positioned, what teachers fear, and what support they believe implementation requires. Unless otherwise noted, quotations from Albanian have been translated into English. Visual artefact codes (V01-V45) and written-page codes (W02-W25) identify positions in the anonymised analytic corpus rather than participants or schools.

The strongest visual claim is that STEM brings elements together. Teachers repeatedly used circles, radial hubs, roots, networks and overlapping forms to communicate interdependence. In V17, S, T, E and M form the four roots of one tree. The disciplines remain named and separate at the foundation, but they nourish a common trunk and productive crown. V40 uses a different grammar: a learner is positioned at the centre of a Venn diagram where the four disciplines overlap, with a problem or question and a project feeding into the model. V25 similarly places "Nxënësi" (the learner) at the centre of a flower whose petals carry disciplinary letters. These artefacts do not simply list subjects; they claim that integration acquires meaning around a shared learner, problem or developmental purpose.

Other artefacts broaden STEM from a lesson to a curricular or institutional structure, V20 places the "school programme" inside a three-dimensional STEM container. V24 describes STEM as global education that forms citizens with competence across the fields of life, while V26 surrounds a learner with a globe, books, mathematical notation, art, music and space. Its annotation states:

> *"Through project we learn about the world, about everything."* (V26)

The written responses confirm this broad integrative orientation, teachers refer to subject-specific and interdisciplinary projects, practical lessons combining several subjects and learning beyond the school building. The richest enacted example is an early-years wheat project that moved from preparing soil and planting to observing growth, harvesting, counting and grouping grains, drawing or painting the stages, and understanding or making bread (W16). Natural science, mathematics and art were organised around a real phenomenon rather than delivered as isolated timetable units. This example is important because it demonstrates substantive integrated practice using ordinary materials, even though the participant did not employ technical language about transdisciplinarity.

At the same time, disciplinary boundaries are highly porous, eight visual artefacts explicitly used STEAM or gave art a prominent place. In V01, science, technology, mathematics, art and English appear, but engineering does not. V16 includes science, technology, engineering and art while mathematics is absent. V45 places science, mathematics and art in one tree without technology or engineering. V22 reinterprets STEAM as a "*system*" that is "*technological, educational, active and modern*". These representations reveal an effort to connect STEM with creativity, language and the whole curriculum. However, they also show that the group did not share a stable boundary between STEM, STEAM and general interdisciplinarity.

The boundary-object interpretation is therefore strongly supported. STEM provides a common name for integration, modernity and active learning, but the exact disciplines and practices under the name vary. The data suggest a shared relational proposition - different areas of knowledge should be brought together around a learner, project or purpose - rather than a shared technical definition of integrated STEM.

5.1 STEM as Active, Project-, Problem- and Inquiry-based Pedagogy

Teachers defined STEM more consistently through what pupils and teachers do than through the four disciplinary labels. Projects are one of the clearest recurring vehicles. V01 places "learning based on projects" beneath a STEM project and connects it to problems and questions. V10 contrasts an unhappy "traditional" learner with pupils exchanging ideas, collaborating and learning through projects. V14 provides the most concise formulation:

> *"Practical activities based on projects and questions*." (V14)

Problems and questions are represented as starting points that generate action. Question marks surround learners, fall like rain, sit above a problem, or initiate a pathway. V30 offers the most developed process representation: a staircase appears to move from problem to question, idea, response or solution, opportunity, collaboration, realisation and school improvement. V19 depicts a movement from confusion and questions through STEM towards mathematics, courage and achievement. These images construct uncertainty as productive, the learner begins without an answer and advances through practical and relational work.

The written responses give practical activity an epistemological role, teachers state that pupils need concrete work to understand concepts, that practical lessons are more comprehensible and attractive, and that children enjoy activities in which they can explore and act. One response report that pupils learned "with desire" and that almost all participated (W08). Other examples include outdoor lessons, continuing classroom projects, informatics activity and organised play with young children. STEM is therefore associated with observable, manipulable and lived experience rather than passive reception.

Learner agency is closely connected to this pedagogy. One teacher argues that the pupil should be:

> "*…free to create and express his or her thoughts*." (W21)

V38 makes the professional role explicit: the teacher collaborates with the pupil, chooses an effective method and then allows pupils to act, imagine, cooperate and explore practically. V05 conveys the same relationship metaphorically through a teacher represented as a watering can nurturing a learner-flower. The teacher is not absent, but authority is reconfigured. The teacher designs conditions, selects resources and offers support; pupils undertake more of the questioning, making and meaning-making.

This pedagogical orientation is coherent and promising, but the technical middle of inquiry and design remains comparatively underdeveloped. Few artefacts or written responses explain how a problem would be bounded, what evidence would be collected, how criteria and constraints would guide making, how prototypes would be tested, or how results would be revised. The data therefore show a strong affinity with active STEM pedagogy without yet providing a common account of disciplinary rigor within the activity.

5.2 STEM as Relational, Developmental, Affective and Civic Formation

A striking feature of the images is its organic and relational vocabulary. Nine artefacts use trees, roots, flowers, shoots or fruit. The repetition is analytically significant because it frames STEM as gradual development dependent on foundations and environmental conditions. V06 labels a large rooted tree "Baza te forta" (strong foundations). V17 uses the disciplines as roots. V18 presents plants at different stages, while V43 shows a fruit-bearing tree. Growth is not instantaneous and not achieved by filling a passive container; it is cultivated over time.

The learner frequently occupies the visual centre, V23 uses a sunflower and text to explain that STEM is focused on the learner and the learner's perspective, with participants growing together as people, learners and citizens. V36 places the learner within a central circle connected to nature, mathematics, a book or device and a planetary object. V40 locates the learner at the intersection of the disciplines. These representations support a relational model in which integration is organised around curiosity, participation and development rather than around subject timetables alone.

Collaboration is similarly treated as part of STEM itself rather than a peripheral classroom-management technique. Ten artefacts clearly represent group work, exchange, support or collective action. V11 shows people climbing and physically helping one another beneath question-shaped rain. V21 connects smiling figures in a network of natural, numerical, geometric, book and device symbols. V35 links STEM with collective work, integration, collaboration, creativity and knowledge. Written responses reinforce this emphasis through references to colleagues, professional exchange, pupil teamwork and broad participation.

Positive affect is even more prominent; 15 visual artefacts contain clear positive or emotional symbols and language. V03 combines a smiling face, a question mark and a heart with the injunction:

"Do everything with heart." (V03)

V41 places creativity, idea, passion and love around a smiling person; V42 reconstructs STEM through success, theory, emotion and opportunity. This is not a conventional disciplinary definition, but it reveals that teachers do not imagine STEM as emotionally neutral. Curiosity, confidence, enjoyment, care and perseverance are part of the educational process they wish to create.

The humanistic orientation extends to citizenship and school renewal. V24 frames STEM as global education; V23 links it to becoming a citizen; V22 overlaps the traditional school with the modern or future school; and V44 states:

"*STEM education is modern, inclusive, has values and endures over time*." (V44)

These themes resonate with the integral-formation language of Catholic education, but the drawings do not contain explicit religious symbols. The finding is therefore not that Catholic identity caused a particular definition. Rather, the teachers' representations place knowledge within a broader concern for persons, relationships, values and social participation. STEM is expected to contribute to capable and responsible lives, not merely to future technical employment.

5.3 STEM Implementation as an Uneven Developmental Continuum

The written responses complicate the highly positive visual narrative by showing that implementation is uneven. At one end of the continuum are pre-awareness and exclusion. One early-years teacher reports that the kindergarten is not included in the project and that this is the first time the approach has been encountered (W24). Another describes the school situation as unclear and states that the class has not yet been introduced to STEM (W15). These negative cases show that access and communication were not uniform across phases or schools.

A larger group uses temporal language of initial orientation: "we are still at the beginning", "the first steps", "we have just become familiar with it", "we are receiving information" and "step by step". One response, written in English, states bluntly:

"*We are not used to do it*." (W03; original English)

These expressions do not convey rejection rather they position STEM as an unfolding reform whose vocabulary and expectations remain unfamiliar. Images V29 and V31 express a comparable uncertainty. V29 describes STEM as "i panjohur" (unknown) while associating it with practical work, engagement and concentration. V31 labels a winding route "Rrugë e panjohur" - an unknown road. Curiosity and implementation uncertainty therefore coexist in both modes.

Other teachers describe emerging or partial practice, schools have "started" but still have work to do; subject-based and interdisciplinary projects have been conducted; the approach has been used "more or less" but not in an advanced form; or activity is concentrated mainly in informatics, suggesting pockets of relevant practice rather than a coherent whole-school model. The classroom may also lag behind school-level intention, a school may have joined a programme while a particular teacher has not yet introduced STEM to the class.

A smaller group describes comparatively established examples, concrete work across subjects, practical integrated lessons, learning outside school, continuing project work, and the early-years wheat project. The contrast between the excluded kindergarten response and the sophisticated wheat sequence is especially important. It demonstrates that early-years suitability is not the decisive issue; organisational inclusion, communication and access to professional learning may be more relevant here. The data cannot determine the cause, but they show that a single network can contain pre-awareness, experimentation and substantial expertise at the same time.

The central interpretive point is that conceptual knowledge of the STEM label sometimes lags behind pedagogical practice. Some teachers identify as beginners while describing projects, practical work, outdoor learning, play and subject integration that align with important STEM principles. They should not be divided simplistically into those who "know" and those who "do not know" STEM. Many are positioned between implicit practice and explicit conceptualisation.

5.4 Flexibility and Gradualism as Prerequisites for Implementation

Flexibility is the most consistent finding in the written corpus. Fifteen of the 24 substantive pages explicitly endorse it. Teachers write "We can be flexible", "There is flexibility in implementing the STEM approach within the curriculum", "It should have flexibility" and "It can and should have flexibility". The recurrence suggests that flexibility is not seen as an optional convenience but as the means through which STEM can be made educationally and institutionally workable.

The meaning of flexibility is contextual rather than unbounded, teachers connect it to pupils' age, the topic, developmental phase, inclusion needs, the specific class and the surrounding school conditions. One response explicitly names age, integration, inclusion and topic as factors that should shape implementation (W06). Teachers seek permission to adapt the form of integration while maintaining an educational purpose.

Gradualism is equally prominent, "Hap pas hapi" - step by step - appears as a practical theory of change. Teachers propose beginning slowly, involving all colleagues, observing progress and moving pupils towards the approach over time. This language parallels the visual journeys, stairs, roots and stages of plant growth. Across modes, STEM is represented as a developmental pathway requiring foundations, persistence and support rather than an immediate institutional conversion.

Flexibility also functions as curricular negotiation. Some participants state that the curriculum is not an obstacle and that STEM can be incorporated within it. Others fear that STEM will prevent them from completing the Ministry programme, following the educational plan or achieving subject objectives. Teachers are not rejecting curricular accountability; they are asking how interdisciplinary work can satisfy it. A rigid model that treats flexibility as dilution would therefore conflict with one of the strongest shared expectations in the data. Equally, flexibility without criteria could allow the STEM label to become so broad that disciplinary purpose disappears- the implementation challenge is structured adaptability.

5.5 Teacher Readiness and the Organisational-relational Ecology of Adoption

Lack of experience is the most recurrent teacher-related constraint. At least 10 written pages refer clearly to unfamiliarity, limited knowledge or confidence. Teachers are still receiving information, considering what they might do, or waiting until the approach is understood more fully. This is a readiness issue rather than a principled objection. The overall discourse remains positive, but optimism is conditional on professional learning and usable examples.

A specific anxiety concerns curriculum completion, five pages clearly refer to fear of not finishing the prescribed programme, pressure arising from the educational plan or concern that subject objectives will not be achieved. These statements matter because they locate resistance within professional accountability rather than personal conservatism. A teacher may value practical learning and still judge it risky if the links to required content and assessment are unclear.

One response observes that anything new requires more work, while another says substantial work remains. Other responses imagine that, once established, STEM may involve "less work for the teacher and more for the pupil". These positions are not necessarily contradictory; they distinguish the planning burden of change from the redistribution of classroom responsibility in a learner-centred lesson.

Agency is present but not sufficient, we see in one teacher that implementation will proceed naturally "if we teachers want it" (W03). Leadership support, colleague collaboration and professional exchange are repeatedly named as facilitators, teachers want to work with colleagues, share experiences across schools and receive encouragement or permission from directors. Adoption of STEM is therefore constructed as collective professional learning rather than isolated trial and error.

Resources and technology occupy an ambivalent position as informatics is an entry point for some classes, and one teacher names lack of technology as the main obstacle. However, the most developed examples in the writing - outdoor integrated lessons, organised play and the wheat project - are low-technology. Visual artefacts also use laptops, globes and rockets symbolically more often than they depict coding, systems thinking or technological decision-making. This tension suggests that some participants may equate STEM with sophisticated equipment even while their own strongest practice demonstrates that high-quality integration can begin with local materials, natural phenomena, measurement and design.

Parental cooperation appears as a barrier on three pages, the responses do not explain precisely what parents are expected to contribute, so the analysis does not infer a mechanism. Nonetheless, parents are positioned within the implementation environment rather than outside it. Together, teacher readiness, curriculum space, leadership, collaboration, resources, parents and programme access form an organisational and relational ecology. Training teachers in isolation would address only one part of the problem.

5.6 Tensions, Silences and Negative Cases

The data contain several productive tensions. First, STEM is both new and already practiced, some teachers encounter the term for the first time; others describe successful integrated activity; and a third group recognises familiar project practices without a developed STEM label. "Newness" therefore refers partly to explicit conceptual framing and programme identity, not to every underlying pedagogy.

Second, the curriculum is both compatible and constraining, some responses say directly that it is not an obstacle, while others fear failing to meet formal objectives. This disagreement may reflect phase, subject, leadership, prior experience or confidence in curriculum mapping; the written data do not establish which factor is decisive. The contradiction should not be averaged away because it identifies curriculum alignment as a central professional-development task.

Third, learner response is overwhelmingly positive but not universal, most teachers expect or report enjoyment, participation, exploration and productivity. One response, however, identifies lack of pupil interest as a barrier, and another notes that some pupils struggle to express themselves. These cases caution against assuming that a practical group task is automatically inclusive. Accessibility, differentiated roles, scaffolding and evidence of individual learning remain necessary.

The most important silences concern technical specificity; engineering design is comparatively underrepresented. Prototyping, criteria, constraints, testing, failure, redesign and optimisation rarely appear. Mathematics is often named or symbolised, but measurement, data analysis, modelling, estimation and justification are not spontaneously foregrounded. Assessment is almost absent; teachers call STEM successful or productive without explaining how disciplinary understanding or individual learning would be evaluated. Time and timetabling are implied through curriculum anxiety but not described as planning structures. Inclusion is valued in a small number of responses, while gender, disability, socioeconomic access, language and rurality receive little explicit attention.

These silences are not proof that participants lack the corresponding knowledge but remain analytically important because recurrent absence identifies what a shared framework and subsequent research should make discussable. Positive affect and integration are more visually salient than evidence, design and assessment; professional learning needs to connect the former to the latter rather than replace one with the other.

6. Discussion

6.1 A Boundary Object with a Shared Pedagogical Core

The findings confirm that STEM functions as a boundary object in this professional community in that the acronym is recognisable and positively valued, yet it carries multiple disciplinary, pedagogical and moral meanings. Trees, flowers, Venn diagrams, networks, projects, global education and modernisation all invoke STEM while organising it differently. This supports the argument that agreement around the label can coexist with substantive ambiguity (Star & Griesemer, 1989; Wong *et al.*, 2016). The teachers do, however, share a pedagogical core: STEM should connect areas of knowledge around practical activity, a question or project, learner participation and collaboration. That core is more stable than the exact composition of the acronym and this finding both aligns with and extends research on teacher perceptions. Margot and Kettler (2019) found that engagement, relevance, collaboration and problem solving were recurring attractions of STEM, while Ring *et al.* (2017, 2019) documented varied conceptual models even after professional development. In the Albanian Catholic-school case, the variation is not limited to alternative arrangements of four disciplines. It includes a strongly developmental and humanistic grammar: roots, nurturing, courage, heart, citizenship, inclusion and school renewal. The data show how a global policy term is translated through locally meaningful professional and institutional values.

Conceptual elasticity is both a resource and a risk. It enables teachers to recognise STEM within familiar project, outdoor, play-based and artistic practices, reducing the distance between policy language and classroom experience. Yet if every attractive or collaborative task becomes STEM, the concept loses explanatory power. The challenge is not to impose a single diagram but to develop shared criteria: which disciplinary ideas and practices are necessary, what makes the connections educationally purposeful, how evidence is used, and where design, testing and revision occur (English, 2016; Kelley & Knowles, 2016; McComas & Burgin, 2020).

6.2 Visual Aspiration and Written Conditionality

The design reveals a distinction that would have been missed by either strand alone. The visual artefacts are predominantly aspirational and metaphorical. They depict integrated growth, journeys, collaboration, positive emotion and a future-facing school. The written responses are more operational and conditional: "not yet", "first steps", curriculum fear, technology, leadership, parents and the need to proceed gradually. The two strands do not contradict one another. They represent different layers of teacher sensemaking - a desired educational identity and a judgement about what present institutions permit.

This complementarity supports a critical use of visual elicitation. Drawings can make relational assumptions and values visible, but they should not be treated as exhaustive accounts of feasibility (Guillemin, 2004; Rose, 2016). The written questions exposed implementation conditions that were largely absent from the drawings. Conversely, a conventional questionnaire might have produced a barrier-dominated account and missed the organic, affective and civic purposes that motivate teachers. The methodological contribution is therefore not simply the use of pictures; it is the systematic dialogue between visual aspiration and written conditionality.

6.3 From Implicit Practice to Explicit Integrated STEM

A major analytical conclusion is that some teachers possess relevant experiential expertise before they possess a stable STEM vocabulary. Outdoor learning, practical cross-subject lessons, play and project work recur across the data. This complicates deficit narratives in which professional development begins by assuming that teachers have no relevant knowledge. Teacher sensemaking research suggests that new policy language is reconstructed through existing frames and routines (Remillard, 2005; Spillane *et al.*, 2002). Productive formation should therefore help teachers name, analyse and strengthen existing practice rather than present imported terminology as a replacement for it. Recognition alone is not sufficient because existing activities may contain strong engagement while leaving disciplinary reasoning implicit. The professional task is to move from "we already do projects" to a more precise analysis of the contribution of science, technology, engineering and mathematics.

6.4 Flexibility, Curriculum and Systemic Change

The prominence of flexibility indicates that implementation is understood as curriculum enactment rather than curriculum replacement. Teachers want professional discretion to adapt activity to age, topic, inclusion and local conditions, but they also fear failing to complete prescribed programmes. This tension mirrors research showing that teachers participate in curriculum construction through selection, adaptation and reorganisation while remaining accountable to formal expectations (Remillard & Heck, 2014). Flexibility should therefore be supported through curriculum mapping, not left as an individual act of risk.

The preferred "step by step" route also challenges one-off innovation models, teachers describe STEM adoption as a developmental process requiring conceptual orientation, examples, joint planning, observation, trial and revision. This aligns with evidence that sustained professional learning and collaboration are needed to compensate for uneven confidence across STEM fields (Barlex *et al.*, 2007; Margot & Kettler, 2019). A three-day event can initiate dialogue, but durable enactment requires structures that continue after the event.

The data also suggest that parental communication and phase access belong within the change strategy. Parents were identified as a barrier without a clearly articulated role, and one kindergarten setting was excluded while another demonstrated advanced integrated practice. Implementation planning should specify why family cooperation is required, avoid transferring school responsibility to parents, and ensure that early-years or less resourced settings are not excluded by a technology-heavy model.

6.5 Humanistic Purpose and Disciplinary Rigor

The visual emphasis on growth, relationship, courage, love, citizenship, inclusion and values resists a narrow technocratic or labour-market conception and resonates with Catholic education's commitment to integral human development and the common good (Congregation for Catholic Education, 2014; Pope Francis, 2015). The absence of frequent explicit religious symbolism is also important. Values enter primarily through educational purpose - what kind of person and community STEM should help to form - rather than through confessional imagery.

A humanistic purpose should not be set against disciplinary rigor, The ethical and civic evaluation of technology requires scientific understanding, quantitative evidence and design competence. Equally, technical effectiveness without attention to consequences can be educationally narrow. Professional learning in this context can connect the two by using local problems concerning water, energy, food, health or ecology. In this way, Catholic educational purpose can deepen rather than decorate integrated STEM.

6.6 Infrastructure, Low-technology STEM and the Policy-practice Gap

The teachers' concern about technology must be read alongside Albania's emphasis on laboratories and smart infrastructure. Material provision is valuable and can expand what is possible, but the data shows that equipment does not define the strongest examples of integration. Gardens, wheat, outdoor environments, counting, art, observation and play generated richer interdisciplinary accounts than many device-centred representations. This supports a distinction between inputs and enactment: laboratories and digital devices require teacher sensemaking, curricular room and pedagogical purpose if they are to become educationally substantive (Albanian Telegraphic Agency, 2025a, 2025b; Xhuxhi, 2025).

A balanced programme should model both technology-rich and low-technology STEM, the former can develop coding, sensing, simulation, data handling and technological systems; the latter can demonstrate that evidence, measurement, design and iteration are possible with locally available materials. This matters for equity across schools and communities. A model in which STEM is synonymous with expensive devices risks turning resource inequality into conceptual exclusion.

7. Conclusion

The teachers in this study do not represent STEM principally as a fixed collection of four school subjects. Across rooted trees, flowers, overlapping circles, projects, question marks, climbing figures, a staircase and an unknown road, they construct a collective visual grammar of integration, activity and development. The learner is repeatedly placed at the centre; the teacher nurtures or facilitates; and the intended destination includes knowledge, creativity, confidence, collaboration, citizenship, inclusion and a more modern school. Artefacts such as the S-T-E-M roots in V17, the learner-centred Venn diagram in V40, the teacher-watering-can in V05 and the problem-to-realisation staircase in V30 make these organising assumptions visible.

The written responses show why this positive vision cannot be equated with established practice. Implementation is uneven, ranging from first awareness and programme exclusion to substantial integrated projects. Teachers speak in the language of "first steps", "not yet" and "step by step". They overwhelmingly endorse flexibility, but their optimism is conditional on understanding, curriculum compatibility, leadership, collaboration, resources and relationships with parents. The most accurate formulation is therefore cautious, conditional optimism: teachers believe STEM can be practical, engaging and productive, but they do not assume that aspiration will enact itself.

The study's principal contribution is to show that the Albanian Catholic primary-school teachers who participated occupy a space between implicit practice and explicit conceptualisation. Many already use projects, practical activity, subject integration, outdoor learning or play, while lacking a shared technical account of how science, technology, engineering and mathematics function together. Professional development should begin from those strengths, not from a deficit assumption, while making engineering design, mathematical evidence, assessment, inclusion and curriculum alignment more explicit.

Material investment remains important, but laboratories and devices cannot substitute for teacher meaning-making. A sustainable approach should combine local and digital resources, humanistic purpose and disciplinary rigor, gradual implementation and institutional support. The rooted tree and the unknown road capture the central tension: the participating teachers imagine strong foundations and valuable fruit, but the route from positive vision to coherent practice still requires shared language, supported experimentation and time.

Ethics Statement

Organisational permission was provided through KKEKSH. Participants completed written informed-consent forms describing the study and anonymisation of responses. Only consenting material was included. Identifying details, school names and raw handwriting are not reproduced because of the risk of recognition within a small professional network.

Data Availability Statement

The raw drawings, diagrams and written response sheets contain handwriting and contextual details that may permit deductive identification. They are therefore not publicly deposited. Anonymised materials may be considered by the author on request where disclosure is compatible with participant consent, data protection and continuing confidentiality obligations.

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Conflicts of interest statement

I declare no conflicts of interest with this work.

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References

Albanian Telegraphic Agency. (2025a, April 7). Manastirliu at "Manastir Congress" school: 80 new STEM labs in our schools. https://en.ata.gov.al/2025/04/07/manastirliu-at-manastir-congress-school-80-new-stem-labs-in-our-schools/

Albanian Telegraphic Agency. (2025b, September 8). Education minister: Some 30 new schools and smart labs open as new school year begins. https://en.ata.gov.al/2025/09/08/education-minister-some-30-new-schools-and-smart-labs-open-as-new-school-year-begins/

Barlex, D., Orchard, K., & Walkerdine, N. (2007). Cross-curricular collaboration in STEM. *Design and Technology Education: An International Journal, 12*(3), 5-15.

Bell, S. (2010). Project-based learning for the 21st century: Skills for the future. *The Clearing House*, *83*(2), 39-43. https://doi.org/10.1080/00098650903505415

Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative Research in Psychology*, *3*(2), 77-101. https://doi.org/10.1191/1478088706qp063oa

Braun, V., & Clarke, V. (2022). *Thematic analysis: A practical guide.* SAGE. Retrieved from https://books.google.ro/books/about/Thematic_Analysis.html?id=mToqEAAAQBAJ&redir_esc=y

British Educational Research Association. (2018). *Ethical guidelines for educational research (4th ed.).* BERA. Retrieved from https://www.bera.ac.uk/publication/ethical-guidelines-for-educational-research-2018

Bruner, J. S. (1966). *Toward a theory of instruction.* Harvard University Press. Retrieved from https://books.google.ro/books/about/Toward_a_Theory_of_Instruction.html?id=F_d96D9FmbUC&redir_esc=y

Bybee, R. W. (2013). *The case for STEM education: Challenges and opportunities.* NSTA Press. Retrieved from https://static.nsta.org/pdfs/samples/PB337Xweb.pdf

Council of Europe. (2018). *Protocol amending the Convention for the Protection of Individuals with regard to Automatic Processing of Personal Data (CETS No. 223).* Council of Europe. Retrieved from https://rm.coe.int/16808ac918

Congregation for Catholic Education. (2014). *Educating today and tomorrow: A renewing passion.* Libreria Editrice Vaticana. Retrieved from https://www.vatican.va/roman_curia/congregations/ccatheduc/documents/rc_con_ccatheduc_doc_20140407_educare-oggi-e-domani_en.html

English, L. D. (2016). STEM education K-12: Perspectives on integration. International Journal of STEM Education, 3, Article 3. https://doi.org/10.1186/s40594-016-0036-1

European Parliament & Council of the European Union. (2016). Regulation (EU) 2016/679 of the European Parliament and of the Council of 27 April 2016 on the protection of natural persons with regard to the processing of personal data and on the free movement of such data, and repealing Directive 95/46/EC (General Data Protection Regulation). Official Journal of the European Union, L 119, 1–88. Retrieved from https://eur-lex.europa.eu/eli/reg/2016/679/oj/eng

Guillemin, M. (2004). Understanding illness: Using drawings as a research method. Qualitative Health Research, 14(2), 272-289. https://doi.org/10.1177/1049732303260445

Honey, M., Pearson, G., & Schweingruber, H. (Eds.). (2014). *STEM integration in K-12 education: Status, prospects, and an agenda for research.* National Academies Press. https://doi.org/10.17226/18612

Jewitt, C. (Ed.). (2009). *The Routledge handbook of multimodal analysis*. Routledge. Retrieved from https://www.routledge.com/The-Routledge-Handbook-of-Multimodal-Analysis/Jewitt/p/book/9781138245198

Kacerja, S., Tasho, E., Zeqo, L., Kafazi, D., Cobani, S., & Vula, E. (2026). Introducing investigative approaches in mathematics teacher education: A case study from

Albania. Education Sciences, 16(7), Article 1126. https://doi.org/10.3390/educsci16071126

Kadriu, E., Fondaj, R., & Cahanaj, E. (2026). Educating across cultures: Experiences of international student women in STEM. *Journal of International Students, 16*(3), 129-150. https://doi.org/10.32674/87rfhw80

Kelley, T. R., & Knowles, J. G. (2016). A conceptual framework for integrated STEM education. *International Journal of STEM Education, 3,* Article 11. https://doi.org/10.1186/s40594-016-0046-z

Komisioni Kombëtar i Edukimit Katolik Shqiptar. (2021). *Teacher professional-development needs questionnaire* [Unpublished internal dataset].

Kosova, R., Sina, Z., Kullolli, T., & Kosova, A. M. (2025). Examining STEM education in Albania: A survey proposal. *International Journal of Advanced Natural Sciences and Engineering Researches, 9*(4), 70-77. Retrieved from https://www.researchgate.net/publication/390746535_Examining_STEM_Education_in_Albania_A_Survey_Proposal

Kress, G., & van Leeuwen, T. (2006). *Reading images: The grammar of visual design (2nd ed.).* Routledge.

Literat, I. (2013). "A pencil for your thoughts": Participatory drawing as a visual research method with children and youth. *International Journal of Qualitative Methods, 12*(1), 84-98. https://doi.org/10.1177/160940691301200143

Margot, K. C., & Kettler, T. (2019). Teachers' perception of STEM integration and education: A systematic literature review. *International Journal of STEM Education*, 6, Article 2. https://doi.org/10.1186/s40594-018-0151-2

Marton, F. (1986). Phenomenography - A research approach to investigating different understandings of reality. *Journal of Thought, 21*(3), 28-49. Retrieved from https://www.jstor.org/stable/42589189

McComas, W. F., & Burgin, S. R. (2020). A critique of "STEM" education: Revolution-in-progress or passing fad? *Science & Education, 29*(4), 805-829. https://doi.org/10.1007/s11191-020-00138-2

Merriam, S. B., & Tisdell, E. J. (2016). *Qualitative research: A guide to design and implementation (4th ed.).* Jossey-Bass.

Pedaste, M., Mäeots, M., Siiman, L. A., de Jong, T., van Riesen, S. A. N., Kamp, E. T., Manoli, C. C., Zacharia, Z. C., & Tsourlidaki, E. (2015). Phases of inquiry-based learning: Definitions and the inquiry cycle. *Educational Research Review, 14*, 47-61. https://doi.org/10.1016/j.edurev.2015.02.003

Pope Francis. (2015). *Laudato si': On care for our common home.* Libreria Editrice Vaticana. Retrieved from https://www.vatican.va/content/francesco/en/encyclicals/documents/papa-francesco_20150524_enciclica-laudato-si.html

Remillard, J. T. (2005). Examining key concepts in research on teachers' use of mathematics curricula. *Review of Educational Research, 75*(2), 211-246. https://doi.org/10.3102/00346543075002211

Remillard, J. T., & Heck, D. J. (2014). Conceptualizing the curriculum enactment process in mathematics education. *ZDM Mathematics Education, 46*, 705-718. https://doi.org/10.1007/s11858-014-0600-4

Republic of Albania. (2024). Law No. 124/2024 on the protection of personal data [Ligji nr. 124/2024 për mbrojtjen e të dhënave personale].

Ring, E. A., Dare, E. A., Crotty, E. A., & Roehrig, G. H. (2017). The evolution of teacher conceptions of STEM education throughout an intensive professional development experience. *Journal of Science Teacher Education, 28*(5), 444-467. https://doi.org/10.1080/1046560X.2017.1356671

Ring, E. A., Dare, E. A., Crotty, E. A., & Roehrig, G. H. (2019). Creating a continuum of STEM models: Exploring how K-12 science teachers conceptualize STEM education. *International Journal of Science Education, 41*(12), 1701-1720. Retrieved from https://doi.org/10.1080/09500693.2019.1638531

Rose, G. (2016). *Visual methodologies: An introduction to researching with visual materials (4th ed.).* SAGE. Retrieved from https://books.google.ro/books/about/Visual_Methodologies.html?id=hsijCwAAQBAJ&redir_esc=y

Sina, Z., Kosova, R., Hajrulla, S., & Gjana, A. (2024). Analysis of high school STEM program impact on students' university performance. *International Journal of Advanced Natural Sciences and Engineering Researches, 8*(7), 233-240. Retrieved from https://www.researchgate.net/publication/384040371_Analysis_of_High_School_STEM_Program_Impact_on_Students'_University_Performance

Spillane, J. P., Reiser, B. J., & Reimer, T. (2002). Policy implementation and cognition: Reframing and refocusing implementation research. *Review of Educational Research*, 72(3), 387-431. https://doi.org/10.3102/00346543072003387

Stake, R. E. (1995). *The art of case study research.* SAGE. Retrieved from https://books.google.ro/books/about/The_Art_of_Case_Study_Research.html?id=ApGdBx76b9kC&redir_esc=y

Star, S. L., & Griesemer, J. R. (1989). Institutional ecology, "translations" and boundary objects: Amateurs and professionals in Berkeley's Museum of Vertebrate Zoology, 1907-39. *Social Studies of Science, 19*(3), 387-420. https://doi.org/10.1177/030631289019003001

Thanasi (Biti), T., & Beqiri, O. (2024). *Bridging the gap: Aligning high school and university mathematics curricula in Albania*. European Integration - Realities and Perspectives: Proceedings 2024, 486-494. Retrieved from https://dp.univ-danubius.ro/index.php/EIRP/article/view/510

von Glasersfeld, E., & Steffe, L. P. (1991). Conceptual models in educational research and practice. *The Journal of Educational Thought, 25*(2), 91-103. Retrieved from https://www.jstor.org/stable/23767267

Wiles, R. (2013). *What are qualitative research ethics?* Bloomsbury Academic.

Williams, P. J. (2011). STEM education: Proceed with caution. *Design and Technology Education: An International Journal, 16*(1), 26-35. Retrieved from https://eric.ed.gov/?id=EJ916494

Wong, V., Dillon, J., & King, H. (2016). STEM in England: Meanings and motivations in the policy arena. *International Journal of Science Education, 38*(15), 2346-2366. https://doi.org/10.1080/09500693.2016.1242818

Xhuxhi, J. (2025). Learning from the past; thinking for the future: Reflections on STEM and its integration in education. *European Journal of Education Studies, 12*(7), 114-130. https://doi.org/10.46827/ejes.v12i7.6069

Xhuxhi, J., & Ramírez-Verdugo, M. D. (2024). *Albanian and Spanish bilingual primary school teacher exchange: Experience, impact, and challenges.* In M. D. Ramírez-Verdugo (Ed.), Transnational approaches to bilingual and second language teacher education (pp. 179-196). Routledge. https://doi.org/10.4324/9781003348580-13

Zyka, E., & Leskaj, E. (2026). Gender composition of STEM programs in Albania vs EU: A comparative analysis. *EuroEconomica, 45*(1), 21-33. Retrieved from https://dj.univ-danubius.ro/index.php/EE/article/view/4031